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Engineering News-Record

Present Reclamation Conditions—*A Staff Review*

Design of Bear Mountain Suspension Bridge

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

FRANK C. WIGHT
Editor

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Congress and Action

LAST Monday being the first Monday in December the federal Congress reconvened. It has a short life ahead of it, and behind it the insistent reverberations of a presidential election which reflects the feeling of the people. Its successor, a year ahead, unless the President wills otherwise, is of quite different complexion and this change will have its effect on the tone and spirit of those who go out in March but who have that hope for future refavor that burns eternal, and of those whose good fortune it will be to remain. Congressmen, if not chastened, should at least be a more reflective lot than those who wasted their own and the country's time in the first session that adjourned last summer. Whether that means more action on the business of the nation remains to be seen. Engineers are interested in a number of measures that are pending, the Muscle Shoals bill, the departmental reorganization and the new reclamation act among others, but about all that can be done, now that the electorate has spoken, is to sit by and pray that the collective message of November 4 has had some effect.

The Engineer is Supplanted

ASSASSINATION has once more proved a trigger to set off the big guns of world politics. The slaughtered Sirdar of Egypt, like the memorable archduke of Sarajevo, becomes a symbol around which move the subtle intricacies of an empire's foreign policy. And, as must increasingly be true in our congesting world, that foreign policy finds its way at bottom to an engineering consideration. With the general policies of the British government in Egypt we, as engineers, have no concern, but we can note that outside the Suez Canal control, the next most potent interest of the empire in Egypt lies in its relation to the Sudan—that vast potential cotton field to feed the textile mills of England. That cotton field will remain a desert except for irrigation, and that irrigation is not possible without drafts on the waters of the two upper Niles which must eventually flow through Egypt. Thus, in the old world comes up the struggle for water, its proportionate and denominate use, which is equally formidable, though fortunately not so bellicose, in our arid West. For years engineering commissions, on one of which the American, H. T. Cory, sat, have been trying to reach a workable solution of the Nile water problem, but even so recently as the time of the recognition of Egyptian sovereignty in 1923 no agreement had been reached. As things look now the assassin's pistol will supplant, temporarily at least, the engineer's reasoning as a basis of agreement.

Road Subgrades and Capillarity

A STUDY of capillary moisture, which has individual merit among the multitude of tests being made of highway subgrades and ground water, is published in this issue. The experimenters arrive at practical conclusions. They are that drains are of small value except as they may reduce capillary moisture by lowering the water table, and that a layer of non-capillary material is an effective agent in preventing the rise of such moisture. The tests were laboratory tests and one naturally looks to the many field tests in progress for confirmation of the laboratory results before freeing his mind of all reservations concerning the very broad conclusions which have been drawn. Perhaps the most interesting of these is that relating to coarse material shut-offs of capillary progress. It hits directly at the economics of road construction. The addition to our present road structure of sub-bases of imported material, particularly clean sand which the tests indicate is the best non-capillary material, boosts the price of roads, in many localities, well above the high figures now being recorded. Cost is the nub of the problem of getting for American highways the deep stable foundations such as are common for example in England. Indeed the problem of stabilizing highway subgrades is profound and its solution calls for much consideration and many more determined facts than are now possessed. The small study described in this issue is a welcome addition to present information.

Another Move Toward Traffic Improvement

LAST May Secretary of Commerce Hoover called together a group of men and women to consider the serious problem of safety in our streets and highways. The procedure outlined was to separate the group into committees of around twenty, each committee to study its specific subdivision of the general problem and to report thereon and when all of these reports had been printed and distributed to have in Washington a "National Conference on Street and Highway Safety." The first part of the program is complete. Committees on statistics, traffic control, construction and engineering, city planning and zoning, insurance, education, the motor vehicle and public relations have been sitting all summer and have made their reports, and the conference is called for the three days beginning December 15. A preliminary reading of the reports shows that the committees have done a good job. As was to be expected the problem is envisaged as something beyond safety, serious as that is acknowledged to be, and goes over into the whole field of traffic congestion with its economic and social complications. No one can present a panacea for the traffic evil, but the committees of this conference have at least laid down the proper methods of approach to the search for a cure. The problem now is how the excellent information and suggestions of the committees can be digested and considered by the whole conference and how the final conclusions of the conference are to be gotten across to the public, who still considers the traffic question in the same class with the weather, to be condemned but never improved.

New Possibilities in Cement

THE setting properties of portland cement have been a major factor in the development of a technique of concrete construction. Because that cement hardens slowly to a major proportion of its final strength, the speed of concrete placing is to a degree restricted and, what is more important, the details of form design and construction become controlling elements in erection of concrete structures. So fundamental has been this slowness of set that engineers have accepted it as the inevitable concomitant of concrete and have predicated their whole philosophy of construction upon it. Nor have the cement manufacturers, except possibly in the academic precincts of the laboratory, done other than to accept this delayed setting as a basic necessity of the material.

It was only a year or two ago that any considerable change in this kind of thinking appeared. The necessity for early high strengths in the concrete of fortifications and gun emplacements in the World War led the army engineers to experiment with some of the obscurer cements, little known outside the laboratory and the patent office, which had the property of early reaching an appreciable proportion of their final strength. Chief among these was the alumina cement. Following the war the obvious advantage of this cement led to a degree of commercial production, first in Europe and later in the United States. In this country the use had been very limited, as it is being produced only in one mill and the engineer and contractor have not as yet become accustomed to the idea of using a new product whose properties are not yet altogether assured and whose price is from two to three times that of ordinary portland. In Europe, however, the spread of the alumina cement has been so great that the portland cement manufacturers, in Germany at least, as a matter of commercial necessity have broken away from their long held notions and are beginning to see if maybe portlands cannot be economically produced which will, too, have this highly desirable quality of reaching an early high strength.

This is a most significant development in the cement industry and in concrete construction. If a portland cement can be commercially produced, at a price comparable with that now prevalent, which will permit the removal of forms in a day or two and the equally early imposition of load, concrete will become a measurably superior material for the constructor. That is so evident it needs no proof or further exposition.

It should be noted, of course, that so far the improved portland cements are only experiments, even in Germany where the most efforts are being made toward their development. The mills there, however, are producing true portland cement with every characteristic of a standard portland except in the setting curve and these cements are testing in one and two day periods up to the strength normally expected in seven and sometimes in twenty-eight days for standard portlands. The problems of manufacture are very great and only by the careful development through ordinary commercial production will a consistent material be reached.

The facts so far available indicate that the necessities in the manufacture of these improved cements lies mostly in a more careful selection and preparation of the ingredients, in a finer grinding and in a more thorough burning. It has long been known that such precautions would lead to a better cement, but the question has always been whether such an improvement was worth while, considering the extra care and consequent extra cost it involved. The experience in Germany seems to indicate that the manufacturers there, driven by the competition of the alumina cement, have come to believe that the trouble is worth while, even though the cost may be slightly increased. Engineers, we believe, will agree that the advantage of a high early strength is so great that, other things being equal, a cement which possesses it is worth more money than the present accepted standard. Just how much more the special conditions of each job must determine.

At any rate, there are signs here that a new development in cement is in prospect which means a great deal to the construction industry. The cement makers, too, are alive to its possibilities and will, it is probable, slowly give over their traditional insistence on the inviolability of the present standard far enough, at least, to investigate thoroughly this new possiblity. There is a good field here not only for the individual manufacturer but also for the co-operative investigation that the Portland Cement Association is carrying on with the Bureau of Standards at Washington.

Is Reclamation Progressing?

MUCH water has gone over the dam since the publication of our comprehensive articles on the crisis in arid-land reclamation a year ago. The Fact-Finding Commission, renamed Board of Special Advisers on Reclamation, made its report. David W. Davis, the illegitimate heir to Arthur P. Davis' position at the head of the Reclamation Service, was himself displaced by Elwood Mead. Miles Cannon also faded out of the picture, and the attempt to make of the Service a political duckpond came to an end for the time being. Under the stimulus of these events, the impotent irrigation committees of Congress for the first time rose above the level of paltry debt-deferment legislation, and accepted a reclamation reform bill; but this bill, tacked onto a deficiency appropriation bill, failed of passage through a one-man fillibuster on the last day of Congress. This event left the officials without authority to carry out much-needed administrative measures, but on the other hand it saved the people's pockets several millions of dollars of appropriations slipped into the bill by pork-hungry congressmen to start irrigation construction in a number of desert districts that were certain to prove financial failures. By this time it seemed inevitable that the reclamation settlers would get deeper into trouble, and the early trend was all in this direction. But later in the season came an unexpected conjunction of fair crops and good prices, bringing the beginnings of prosperity to the farmers.

Amid these far-reaching changes, what has happened to reclamation? Are its difficulties over? Is the disruption of the engineering division checked? Have the project land-owners come to realize that continued refusal to pay their debt to the government is poor business? Is reclamation progressive? Such questions as these were placed before W. W. DeBerard, of the editorial staff of this journal. He has written his answers in two articles, summarizing the results of a brief trip of check-up inspection and interviews. The first article appears in this issue.

Without undertaking to comment on his conclusions at present, we have to refer to a further phase of reclamation progress which also is of immediate concern,

and in some respects may be said to be at the heart of the present problem of reclamation.

While the changes just mentioned were taking place, while F. E. Weymouth, having decided to resign in order to find relief from the harassment of political bureaucracy, was winding up his affairs as chief engineer of the Reclamation Service, and while Mr. DeBerard's trip of inspection was under way, a number of proposed new reclamation projects were being studied by boards of engineers and committees of business men with a view to determining whether they will be sound business enterprises. The reports of these boards and committees, which should be made public soon, will bring our national business sense face to face with a very plain question, namely, whether the nation can afford to engage in basically unsound business.

Heretofore Congress, insistently prodded by enthusiastic local boomsters, has decided time and again that the nation *can* afford to do so. This is evidenced in a regular sequence of reclamation appropriations devoid of all business safeguards and (in view of the persistent defaulting of previously built projects) sure to result in large losses. Yet, however unwise any of these appropriations may have been, they are the embodiment of golden wisdom when compared with the appropriations now being asked for new projects. The old projects cost roughly from $30 to $85 per acre to build, which expenditure the land-owners insist that they cannot repay as they contracted to do. The new projects, however, will cost $125 to $200 per acre (we say this on good information, though the official reports have not yet been given out). Can and will the land-owners repay these sums? It may be that unusually favorable climate and super-excellent soil will assure the new projects such large and valuable crop yields that even these high irrigation costs can be paid. But unfortunately the fact is that the climate and soil quality of the new projects instead of being superior will very probably prove inferior. Does this give better assurance of repayment? No; by all human experience, it makes the failure of these projects more certain. Unless agriculture can be made to thrive and the land-owners induced to farm so efficiently that they can repay the initial cost, the new projects will only create more misery and poverty, in place of wealth and happiness.

Is this good business? Surely not. Yet this is the kind of business that Congress will set up if it follows the course of easy habit and appropriates more millions for reclaiming more areas of the desert. Unless, that is, new ways are found for pushing a reclaimed area onward to success, and for holding the land-owners up to their obligations as is done by sugar companies, merchants and bankers.

Either way, the issue is a fundamental one: Whether the country can afford to engage in unsound business, or whether it is bound to make sure that the business is sound, or can be made sound, before it enters upon it.

Mr. DeBerard's reference to the Spanish Springs extension of the Newlands project touches on these questions in another way. Spanish Springs is not a new project, but a development which, it is hoped, will reclaim a project that has suffered repeated misfortune. Undertaking the construction of this reservoir is a salvage operation rather than a new venture. Yet it, too, presents the problem of finding new ways for dealing with land development if serious future difficulties are to be avoided and if the project is to be made a help to the region rather than a burden. To this extent the problem of Spanish Springs is quite the same as that of the wholly new projects that are being urged, such as those in Oregon and Utah.

Our governmental affairs generally appear to be entering a period of more businesslike administration. This fact gives ground for hoping that Congress may become businesslike in its dealing with reclamation. If it does, it will insist that each new federal reclamation enterprise shall first of all be shown to be sound business, and will prescribe sound business rules for dealing with those to whom the government lends its money. It will refuse to let the government be drawn into wildcatting operations. It will aim to help the home seekers instead of the pap-seekers, as Mr. DeBerard puts it.

We Deny An Allegation

WE RISE to a point of personal privilege.

In the current *Proceedings* of the American Society of Civil Engineers there appears the following sentence in a communication from Maj. Gen. (retired) Lansing H. Beach, Corps of Engineers, U. S. A. " . . . at the same time that a prominent technical journal, which has for some time past gone out of its way to attack the Corps of Engineers, was declaring in an editorial, 'It is becoming increasingly apparent that the campaign for a federal Department of Public Works is to succeed or fail on the issue of the removal of non-military activities from the control of the Corps of Engineers of the army.'" As the quotation is from our columns we must assume that *Engineering News-Record* is the "prominent technical journal" referred to.

The former Chief of Engineers is in error.

Engineering News-Record has never attacked the Corps of Engineers. It has advocated a Department of Public Works; it has condemned the inherent aristocracy that the Corps of Engineers creates; it has expressed the hope that some better method than that existing could be devised whereby the army engineers would gain that proper, though hitherto not too apparent, combination of a technical all round efficiency and a sense of responsible direction of work which is so necessary for them and the country in time of war. But, it has recognized the problems of the corps, it has had sympathy with them and it has opposed any proposal to make of the corps only another military branch of the army.

General Beach and his followers, a minority in the corps, and on the other side some ardent promoters of the Department of Public Works, have been trying to foment a feud between the military and civilian branches of the engineering profession. *Engineering News-Record* has no sympathy with such an intention and it has done in the past and will do in the future what it can to further an amicable solution of the problem of properly conducting our public works system, at the same time preserving the integrity of our necessary military engineering organization. It is reconciled to the attacks by zealots of both sides, for they indicate the fairness and propriety of the middle ground.

But *Engineering News-Record* is more concerned with the future of engineering and the national defense than it is with group animosities or ambitions.

Notes on Western Reclamation—I

This is the first of two articles on changed conditions in reclamation. It deals with some northern projects. A second article will tell of southern projects.

Summary of an Editor's Inspection Trip

By W. W. DeBerard
Western Editor, Engineering News-Record

THIS FALL I was commissioned to revisualize the irrigation situation for *Engineering News-Record* to see what changes had come about during the past year from the conditions reported last year by F. E. Schmitt in his "Survey of Reclamation," and incidentally to have a few heart-to-heart talks with the engineer operators of the projects for the purpose of bringing to them that friendly encouragement which their brother engineers in the East feel for them.

Since last year's survey, reclamation has been placed under new direction. As everyone knows, Dr. Elwood Mead is Commissioner of Reclamation, and his intense interest in farm economics, tenantry and settler selection is just as well known. I had a chance to interview the commissioner before starting on my trip. Naturally (inevitably, I thought), he talked first of farm prosperity and helping men to own farms. But then he had something to say about the fine fellows on his staff out in the field, how they were sticking to the job and wrestling with their problems, sometimes under adverse conditions imposed by meddlers. "Tell the boys," he said, "I'm back of them. Encourage them all you can, and get the facts. I haven't seen for some time some of the projects you will visit. Look them over carefully. And here are letters asking the men to do everything possible to aid you."

I write these notes after visiting Denver, Grand Junction, Provo and Salt Lake. Interviews at Salt Lake, Sacramento and Berkeley covered Idaho, Nevada and California projects which I did not see. Three subjects I tried to keep in mind at all of these places: Farm economics, morale of the bureau, and legislation. But, in addition, at all of the projects, extensions, improvements, auxiliary power and brand new units inevitably come up for discussion. The West is not finished and there is no place in it for a man who thinks much of anything is complete. The West is still full of the long-headed, hatchet-faced, light-haired, blue-eyed pioneers who make the world progress.

Farm Economics—In the field the big question is: How are the crops, and what is the market. There is much less opportunity for useful discussion of the gentle art of making black or red ink entries at the end of a balance sheet, the judgment which leads to physical success, home comforts, and favorable bank balances.

Co-operative marketing gets some attention. It is fostered by the project superintendents, as is also crop rotation and advice on the choice of crops. Fruit—where it can be raised well—has a lure, but trees are coming out both in Colorado and Utah, to be replaced by more dependable crops, as alfalfa and sugar beets. Dairying is on the increase.

The farmers' ability and disposition to pay off government obligations are about as reported last year; more favorable in some cases, in some less. Now and always on the projects, *the government will be the last to get its money*, unless new laws are passed.

This does not mean, however, that irrigated farms are poor financial risks. Minneapolis mortgage bankers operating in the Idaho district have few delinquents, and consider their loans safe and desirable. "You can't blame the farmer for paying his government obligations last, considering the demoralizing propaganda Secretary Work's emissaries put out a year ago," said more than one project resident. "Anything you want," was the Field Commissioners' message to the settlers; Miles Cannon preached repudiation indiscriminately and effectively. It will take five years to overcome the effects of this loose talk, in the opinion of those who best know conditions.

Up in Idaho the farmers are sore, but what their grievances are based on they scarcely know. Being sore, they must have a scapegoat; why not the Bureau of Reclamation, to which they owe money? Conditions are even more chaotic than a year ago. The hardest man to deal with is the man that has been dealt with too leniently, and by now the situation is almost out of hand. Leniency to the deserving is believed in by most people, but in a good many cases a little of the General Dawes treatment would be healthful.

Business Methods—As to the farm prosperity talked of lately: In general the farmers are somewhat better off than a year ago. The project superintendents I talked with indicated that the delinquencies could be reduced to insignificant proportions had they the power and authority to handle them directly, as would a mortgage house. Authority to accept chattel mortgages on stock or farm improvements which could be discounted at the bank is one thing suggested. Collection of O & M (operation and maintenance) charges at the beginning of the season before the water is turned on is another—and this, by the way, was provided in the bill that failed of passage in the last minutes of the session of Congress last spring. No coddling, but cold-blooded business methods, and a realization that the project farmers are no worse off (better in most cases) than are the farmers in the rainfall areas of the East, will do much to clean up the so-called reclamation problem. On every project which I visited I found that Mr. Schmitt had reported accurately; "Nothing new to say on the subject," was the general remark.

Morale—Better morale appears to exist in the field forces than in the offices. Perhaps that is because the "investigators" did not spend so much time in the field. Anyway, the field forces have investigation-proof records of costs, based on the best system of

cost accounting that can be devised. The system is so good that it is copied all over the world, and contractor after contractor has gone into it to his own advantage. If the 21-year-old Reclamation Service did nothing else, it left a permanent, detailed cost record, distributed, unitized and pigeonholed in every conceivably useful way. So when the Secretary complained that he couldn't get costs, the investigators had to answer, like the colored man, that they could get nothing else *but*. At one project three successive sets of investigators came along, each trying to "get something" on the project management, yet finally even the crookedest ones had to give up in despair. Naturally the field force on this project has not had its morale lowered. Secretaries come and go, but the staff goes on forever.

Perhaps nothing has so much stirred up the field offices as the authority conferred on the chief clerks. The dual-head arrangement that Secretary Work set up will not operate. In fact it is not now operating, except in name. Most of the chief clerks and superintendents are close friends, and in consequence get on just as before. The settlers are at sea when the clerks attempt to utilize their authority, and come to the superintendents anyway. It is a small thing to worry about, but having two heads in one office is irritating and illogical.

On the whole I can report that morale is better than I thought to find it. The staff is loyal to the job and to the organization as a whole. If only the Secretary were as loyal to his staff there would be no morale problem. Loyalty is there in full measure, far in excess of what the Secretary has deserved. Engineers, as a class, are almost always loyal to a fault to the organization to which they are attached.

Legislation—Admittedly the hurried legislation proposed at the last session of Congress is not the best that brains can devise. Probably it was well that it did not pass. Time has been given to put something better in shape, and also to get some needed horse-sense study on the proposed new projects. Dr. Mead has had the latter done locally by experts—bankers, business men and farmers. Half a dozen state agricultural colleges have extended the services of experts on soils and farm management. Calculations have been made as to how the farmer can be expected to come out.

For instance, for the Spanish Springs project in Nevada, Prof. David Weeks, University of California, and his committee made more than a hundred combinations of schemes of agricultural development, construction, repayment and rates of interest. The committee, said Professor Weeks, has looked at the problem in a hardboiled way. Under the present law, or the proposals of the Factfinding Commission, the project is not feasible. Only a heavy loan investment by the government and expert supervision to protect the loan will make it possible for the farmer to succeed. Essential features of a proposed contract between the settler and government as outlined by Professor Weeks' committee are as follows:

(1) The settler should have specific qualifications.

(2) He should have a certain amount of capital in cash or its equivalent, or furnish a bond to establish his good faith.

(3) Plans and specifications should be included for buildings, fences and permanent crops.

(4) A program of development and capital requirements should give the basis on which funds are to be advanced by the government.

(5) The settler agrees to purchase the equity of the government at actual cost to the government, with a low rate of interest on deferred payments.

(6) The settler should be considered as the contractor and should be made responsible for the performance of sub-contractors engaged to build buildings and other improvements.

(7) An agricultural program agreeable to the farmer and the government should set forth a schedule of land utilization, livestock and farming methods, with expected yields and income and a schedule of repayment.

(8) The contract should be unassignable except with the permission of the government.

While the recommendations of the Factfinding Commission will greatly facilitate carrying out the above program, the committee suggests that the government should finance at a low rate of interest on deferred payments complete reclamation, including irrigation works, domestic water supply, land leveling, planting of 20 acres of alfalfa, agricultural development, stock and equipment. Some order! But the government would in any event have $9,000 invested to the settlers' $1,500. It is to the government's advantage to gets its money back in the quickest way. The period of development, suggests the committee, should be six years, at the end of which time construction and development expense should be embodied in one plan of repayment at 4 per cent interest. Under this plan in 20 years more the settler would be able to clear his land of debt.

The advantages claimed for this plan are that (1) help comes when needed most; (2) most settlers will clear their land of debt in their own lifetime; (3) the government is not called upon to advance money without interest, which is a subsidy; (4) the financial problem is simpler in accounting than it would be were construction and development kept separately; (5) the public would not be deluded, as it is at present, into the belief that it was conferring a great favor on the reclamation farmer by giving him money for reclamation. The settler receives more help with less expense to the government.

Finally, the committee recommends that the Newlands Project as well as the additional lands under the Spanish Springs development be at once divided into 5,000- to 10,000-acre units for agricultural development and colonization, and—most noteworthy of all the suggestions, but imperative—that the large holdings of developed lands be purchased by the government and made a part of the program.

The above has been given in detail because it indicates the serious, thorough way in which the economic problem of one of the "lame duck" projects has been studied. Equally important is the engineering problem of how to get more water at once for existing units of Fernley and Swingle Bench lands. Upstream diversions (legal or otherwise) have seriously reduced the available water. Incidentally, it may be noted that, all rights being waived for the time being, Lake Tahoe this year was drawn on by a temporary pumping station hastily put together.

When thinking of the Newlands project I'll never forget the remark of an engineer, long since out of government employ, made eight years ago while we

sat outside a shack eatinghouse in Fallon waiting for the dinner gong. "No settler can succeed here unless he has $4,000 to $5,000 to start with, and anyone with that amount of money would be worse than a damn fool to come here." Even at that time the poor settler had no show, in the engineer's estimation; but there was nothing the engineer could do to help him.

Perhaps the most frequently repeated suggestion as to legislation was to get an irrigation district law into operation as soon as possible. Under a district, charges are collected as taxes, paid at the beginning of the season instead of at the end of the season as now. Another vitally important suggestion is that, if leniency is to be granted to deserving individuals, discretionary power should be lodged locally, in the project management. Perhaps no better illustration of this can be given than from Orland, the prize project so far as repayment of the government cost is concerned. Precipitation last season was 50 per cent of the mean seasonal amount. Runoff was 6 per cent of the mean seasonal at East Park Dam and only 8 per cent near the diversion. East Park reservoir contained only 12,250 acre-ft. (about one-fourth its capacity) at the beginning of draft. Only 0.7 acre-ft. per acre could be delivered to the land, which is less than one-fourth of the normal requirement. Only 12,000 acres were irrigated, the smallest area since 1916. The crop yield was $21.70 per acre against a mean of $49.80 for the past 10 years. Some permanent damage was done to alfalfa, but few orchards were lost, although the tree crops were materially reduced. Appeal for a 6-month deferment of construction cost payment, with a special 5 per cent penalty, such as has been granted to other non-paying projects, rather than the customary 12 per cent penalty, seemed to be a logical request. Such requests ought to be granted or refused on the ground, not 3,000 miles away.

Orland will pay, and, further, it will probably authorize an expenditure for supplemental storage amounting to at least $75 to $100 per acre additional, on top of the present $55 cost. Particularly will the project do so if the terms of repayment provide for paying the increased charge *after* conclusion of payment for the present building cost. Thus is seen the local problem, which requires local settlement, not a general law to apply to all projects but one which will give the local representative of the government more discretion and latitude.

Beyond question, Mr. Schmitt's conclusion of a year ago that blanket deferment is unsound is supported by my observation. But individual extensions for cause (ascertainable only on the ground) should be authorized on businesslike terms. No one is better able than the locally experienced superintendent to extend this help. His judgment far exceeds that of any one sent from Washington. In strengthening or broadening rather than restricting the responsibilities and powers of the local administration, as Mr. Schmitt pointed out, lies the key to the whole situation.

To summarize my observations to date: Disorganization of staff and morale does not stand still. On some projects the working spirit is slightly better than last year, but on most of them it is not much changed. The dual system of control has wreaked havoc, but working agreements are in force which permit business to go on after a fashion. The proposal in the report of Prof. Weeks for the government to buy and resell land is revolutionary, in spite of which it may be a wise—even necessary—thing to do. Legislation is necessary to make it possible. New legislation is required anyway, not only for running the new projects but for dealing with further reclamation. Finally, from the standpoint of the East as well as the West, the strongest argument exists for stopping all appropriations for new projects until the new laws have proved suitable and until there is a demand from real farmers rather than pap seekers.

Richmond Puts Shockoe Creek into a Concrete Conduit

Methods and Costs of Constructing Concrete Drain in Bed of Creek Carrying Water and Contracted by Bridges

BY ALLEN J. SAVILLE

Recently, Director of Public Works, Richmond, Va., now Engineer and Contractor, Richmond, Va.

WITH A DRAINAGE area of 11 square miles Shockoe Creek in the city of Richmond flashes into flood in an hour and inundates considerable sections. In years past the channel has been walled in and in places where streets cross it is bridged over, generally by masonry arches. With time the walls have in part fallen in and the crossings deteriorated and always there are the periodical overflows. Therefore, in August, 1923, the city authorities made available $3,000,000 to reconstruct

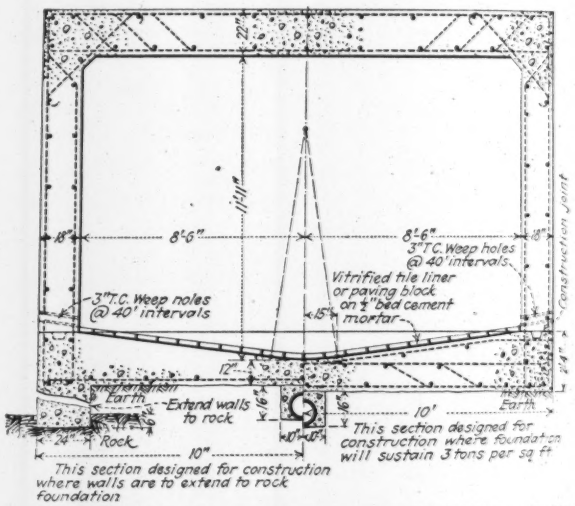


FIG. 1—SECTION OF SHOCKOE CREEK CONCRETE DRAIN

the old walled channel and to add 7,200 ft. of new conduit. It is the first portion of this work—the reconstruction of the old channel—which is considered here. This was undertaken first because it was desirable to get all the relief possible as soon as possible and there were no right-of-way complications to delay work.

In debating the general policy of construction, force account was decided upon for two principal reasons: (1) The Department of Public Works was prepared to begin work quickly and it actually did break ground in two weeks after the money was appropriated; (2) the operations were to be in the creek bed which is subject, under normal rainfall, to a 4- to 6-ft. flood, whose crest reaches Main Street in 45 min. It was expected that the

contractors would bid high to cover this risk—indeed estimates by several set the damage costs at from ten to thirty thousand dollars—so that should the flood conditions prove easy the city would profit by doing its own work.

Drain Structure—About 1,700 ft. of conduit was decided on for the first operation. With East Main St. as

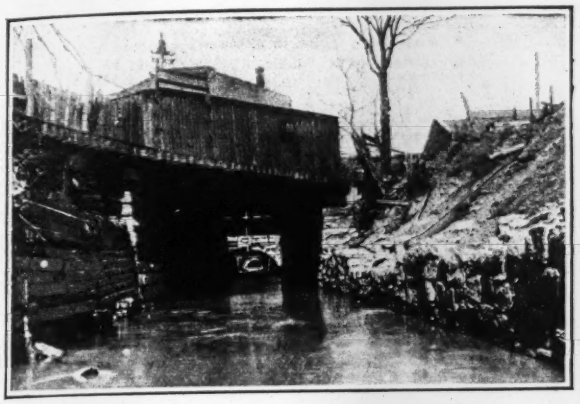


FIG. 2—CONDITION OF OLD CHANNEL OF SHOCKOE CREEK

the dividing line, the 1,700 ft. was separated into two construction sections 759 ft. long and 941 ft. long. Fig. 1 shows the drain section; it varies from 15½ ft. to 17 ft. wide but is constantly 11¾ ft. high. The notable detail is the invert lining of 9x16x1½-in. vitrified tile. The section has a capacity 50 per cent greater than the old channel.

Construction Plant—Construction simultaneously in two sections made necessary two excavating and concreting outfits. The excavating equipment was: two ¾-cu.yd. revolving steam shovels, one being rented; one ¾-cu.yd. clamshell bucket; four 4-in. single-acting gas-driven suction pumps; one 6-in. gas-driven centrifugal pump for emergency use; six ¾-cu.yd. steel dump buckets; two 1-ton Ford trucks and 300 ft. of 5x2½-ft. steel flume in 9-ft. sections. The concreting outfits were bought on the basis that 10 ft. of conduit a day would be completed on each section. For each section it comprised one 1-bag Jaeger mixer with a 50-ft. track for the traveling dump bucket and 50 ft. of spout; and for each section 180 ft. of inside wood forms in 4-ft. sections with I-beam cross-braces. The total outlay for construction plant was $25,000, and it is estimated that there should be 50 per cent salvage.

Construction Methods—The conditions under which construction had to be conducted can be visualized by the view Fig. 2. In the view three crossing street structures are in sight and about the normal flow of water prevails. The stone walls were about 4 ft. thick. Portions of the masonry had fallen into the bed and in places it came inside the section of the proposed new drain and had to be removed. The material to be excavated was, therefore, a mixture of stone and gravel. The prism to be taken out averaged about 4 ft. deep and 20 to 25 ft. wide. Water, however, was the controlling condition.

The plan of construction was to dam at each end a 144-ft. length of channel, divert the flow between dams through a flume, lay dry the area inclosed by the dams and in this area build the bottom half of the drain. The procedure was as follows: In a section of 144 ft., posts were driven into the bottom, about mid-width of the channel, spaced 5 ft. transversely and 9 ft. longitudinally. These were connected by string pieces and caps, forming a trestle to carry the flume of 9-ft. sections bolted together as indicated by Fig. 3. At the ends of the flume sandbag dams were built, the upstream dam having a rough sheeting on 4x6-in. posts driven across-channel 4 ft. into the bottom. Pumps set on the flume at the dams laid dry the channel between them. With the upstream dam occupying 18 ft. and the downstream dam 12 ft. there was a clear space for 114 ft. of structure. A crane and clamshell made the heavy cuts on each side of the flume and the work was finished by hand.

At the street crossings excavation involved the removal of the old arches. There were four of these. First the arch rings were laid bare by excavating from

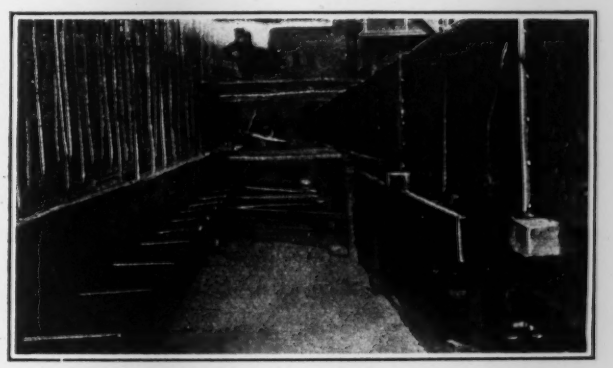


FIG. 3—CONCRETING INVERT WITH FLUME BYPASSING THE WATER

above. Then a 1,500-lb. pile hammer, operated by a crane, was set to work driving down the keystones and collapsing the arch. In one case the drain invert was built before removing the old arch. Here a timber platform was built over the invert to receive the falling masonry.

In placing concrete the invert and lower side walls, as shown by Fig. 3, were built first. This concrete was put in in 16-ft. sections which could be excavated in one day and concreted the next day. No forms were used for the invert. The lining tile was laid in a ½-in. bed of 1:2 mortar, one setter and three helpers laying 1,200 sq.ft. a day. The side walls were concreted against the excava-

TABLE I—FINAL COST OF SEWER IN BED OF SHOCKOE CREEK; LENGTH 1694.38

Item	Unit	Total
7,011.19 cu. yd. Earth Excav. main sewer	$4.3906	$30,783.33
1,561.47 cu. yd. Masonry Exc. main sewer	4.3906	6,855.73
165.47 cu. yd. Earth Excv. connections inlet, etc.	4.3906	726.51
1.45 cu. yd. Masonry Excv. connections inlet, etc.	4.3906	6.37
14.00 cu. yd. Masonry Excv. for underpinning	4.3906	61.47
6,334.90 cu. yd. Reinforced concrete main sewers	10.98	69,557.20
143.53 cu. yd. Extra concrete in invert	10.98	1,575.96
205.84 cu. yd. Extra concrete in side walls	10.98	2,260.12
16.85 cu. yd. Concrete in walls and grading boxes	10.98	185.01
18.88 cu. yd. Concrete in side walls	10.98	207.30
846,964.49 lb. Steel in main sewer	.03738	31,659.53
25,162.51 lb. Misc. steel connection slabs, paving, etc.	.....	940.61
3,094.30 sq. yd. Tile liners in sewer	2.94	9,082.33
1,909.38 Lin. ft. 4 to 24" TC pipe	1.5437	2,498.54
13.84 cu. yd. Brick underpinning	8.698	120.38
9.20 cu. ys. Brick in sewer stacks	8.698	80.02
37.6 cu. yd. Brick in wall	8.698	327.04
11.89 cu. yd. Brick in piers for sidewalks	.....	103.41
990 sq. yd. granite spall paving removed and replaced	.7337	726.43
24 sq. yd. Brick sidewalk removed and replaced	.58	13.92
9.00 sq. yd. V. B. paving removed and replaced	.95	8.55
245.20 lin. ft. Granite curb removed and replaced	.167	40.96
8,753 cu. yd. Excavation—cost of dams and flumes	.975	8,535.50
8,753 cu. yd. Excavation—cost of floods	.314	2,749.09
6,903 cu. yd. Concrete—cost of forms	2.36	16,278.89
Miscellaneous charges	.....	4,784.88
		$190,169.15

tion and the inside forms were 3x16 ft. braced as indicated by Fig. 3. With the bottom section, as shown by Fig. 3, concreted, the flume and trestle were dismantled and moved ahead to a new length and water was turned into the concreted length. After the work got in full swing a force of 25 men took apart, moved and reassembled 144 ft. of flume and put in the end dams in one day. The coffer was pumped out during the night and excavation began the next morning.

After the bottom concrete had set about a week, the top forms were placed. These are shown by Fig. 4. Both side and roof units were 4 ft. long. The side units were set on 6x8-in. timbers bolted to the lower section of the wall; the bolts for these bearing stringers are seen in Fig. 3. The forms are otherwise braced by diagonal haunch ties and by 4x6-in. cross-braces spaced 4 ft. With the bearing stringers, adjustments of the forms were easily made by wedges. The outside forms were of rough lumber.

Progress and Costs—Floods have damaged the work to the extent of about $3,000. This small figure is due largely to the design of the flume, and to the height of the drain and its open area in section when the top forms are in place (see Fig. 4). The flume was anchored by cables and the top form so rigged as not to wash away. The only things in the construction which could be destroyed by high water were the two dams at the up and downstream ends of the flume. These cost approximately $300 to build and here was the principal part of the $3,000 expenditure due to flood damage.

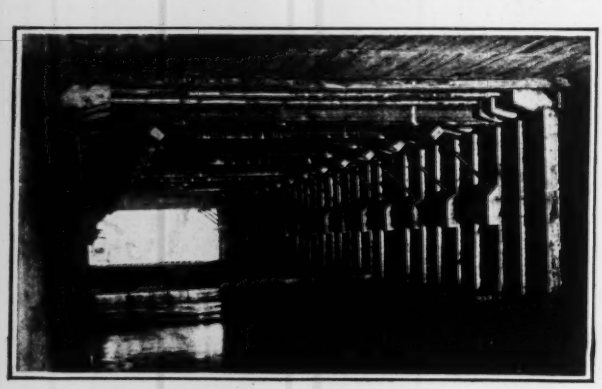


FIG. 4—FORMS FOR UPPER SIDEWALLS AND ROOF

A general superintendent with a general foreman for each section with 1 concrete, 1 excavation and 1 carpenter foreman, constituted the construction force. The engineering force which took care of all alignment work, estimates, unit prices, grades, etc., was composed of one engineer in charge with a transitman and two rodmen. A purchasing agent and one clerk bought all supplies and made up all payrolls and acted as paymaster.

Table I shows the quantities and costs of the whole work, and Table II the itemized costs of a representative day's work. A summary of the progress and cost records is as follows:

Excavation started Sept. 4, 1923, and was completed March 7, 1924; total time, 160 working days. The total amount of material excavated was 8,754 cu.yd., including approximately 1,651 cu.yd. of masonry, or 54.7 cu.yd. excavated per day at a cost of $4.39 per cubic yard including backfill. The first invert was poured Sept. 17, 1923, and the last top was poured March 25, 1924; total time, 164 working days. The total amount of concrete poured was 6,720 cu.yd. or 40.98 cu.yd. poured per day at a cost of $10.98 per cubic yard, including cement. Including cement and forms gives a cost of $13.41 per cubic yard. Including the forms, but deducting the cost of cement at $2.78 per barrel gives a cost of $9.23 per cubic yard.

TABLE II—AVERAGE DAY'S COST OF CONCRETING A 16-FT. SECTION

Taking down and erecting 16 lin.ft. of inside wall and top forms, approximately 522.5 sq.ft.	
1 Foreman 9 hr. at .75	$6.75
1 Carpenter 9 hr. at .60	5.40
4 Laborers 9 hr. at .35	12.60
	$24.75
Cost per sq.ft. of forms	0.047
This figure includes the handling of I-beam supports, the taking down, moving the forms ahead inside the completed sewer a minimum distance of approximately 50 ft. and erecting them ready to place concrete.	
Setting side and top steel—16 ft. length of sewer approximately 3,904 lb.	
1 Foreman 2½ hr. at .75	$1.875
5 Laborers 2½ hr. at .35	4.375
	$6.250
Cost per lb.	0.0016
Setting invert steel 16 ft. length of sewer, approximately 5,176 lbs.	
1 Foreman 2 hr. at .75	$1.50
5 Laborers 2 hr. at .35	3.50
	$5.00
Cost per lb.	.0009
Pouring 16 ft. length of invert approximately 27 cu.yd.	
1 Foreman 3 hr. at .75	$2.25
1 Mixer Runner 3 hr. at .65	1.95
9 Laborers 3 hr. at .35	9.45
	$13.65
Cost per cu.yd.	0.51
Pouring 16 ft. length of top and side wall, approximately 35.7 cu.yd.	
1 Foreman 4½ hr. at .75	$3.375
1 Mixer Runner 4½ hr. at .65	2.925
9 Laborers 4½ hr. at .35	14.175
	$20.475
Cost per cu.yd.	0.57

The total cost of engineering, purchasing and material, supervision including all office and field work was $6,796.80 or 3.5 per cent of the total amount expended.

These figures include a liberal estimate for depreciation of equipment and of course complete absorption of costs of small tools and equipment. Rent of office and all charges ordinarily carried by the contractor are included. Some work was done nearly every Sunday and at certain periods considerable overtime was put in. There was not enough of either materially to affect the general results.

Thomas Towles had charge of the design, T. B. Merrick general charge of construction and A. M. Harris was resident engineer on the work.

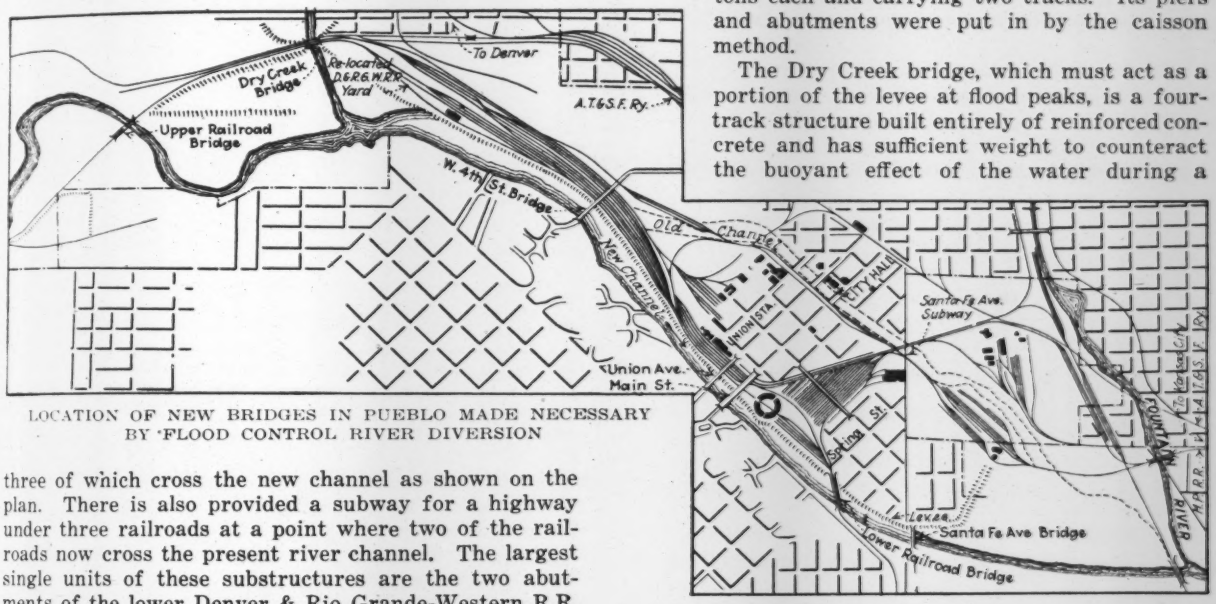
French Reconstruction Almost Complete

According to statements given out by authorities in France, approximately eighty per cent of the houses destroyed during the war had been rebuilt by July of this year; ninety per cent of the damaged canals had been reconstructed; eighty per cent of the trenches used by the troops of both armies had been filled in; and eighty-eight per cent of the damaged factories had been put in operation, says the European division of the Department of Commerce. Much of this is due to the energy and industry of private individuals and owners. Agricultural land has been reclaimed, populations have been returned to their original dwellings, and manufacturing and mining industries have been put into operation. Since that time reconstruction has gone forward at an increasingly rapid rate.

Foundations for Bridges in Pueblo Flood Control Project

Diversion Requires Eight New Bridges—Substructures in Main Channel Built in Caissons Sunk to Rock

OPEN TOP concrete caissons irregular in shape built on the site on dry land and subsequently sunk to rock by excavating the interior form the shells for the foundations of bridges crossing the new channel of the Arkansas River through Pueblo, Colo. The three miles of new channel through the city is the principal feature of the Pueblo Flood Control Project (see *Engineering News-Record*, July 12, 1923, p. 48). Abandonment of the existing channel requires the construction of three railroad and five highway bridges, all but



LOCATION OF NEW BRIDGES IN PUEBLO MADE NECESSARY BY FLOOD CONTROL RIVER DIVERSION

three of which cross the new channel as shown on the plan. There is also provided a subway for a highway under three railroads at a point where two of the railroads now cross the present river channel. The largest single units of these substructures are the two abutments of the lower Denver & Rio Grande-Western R.R. bridge which contain 1,800 cu.yd. each. This bridge and two other railroad bridges and one highway bridge are under construction. All of the foundation work will require 19,000 cu.yd. of concrete, 8,600 cu.yd. of wet excavation and 7,000 cu.yd. of dry excavation.

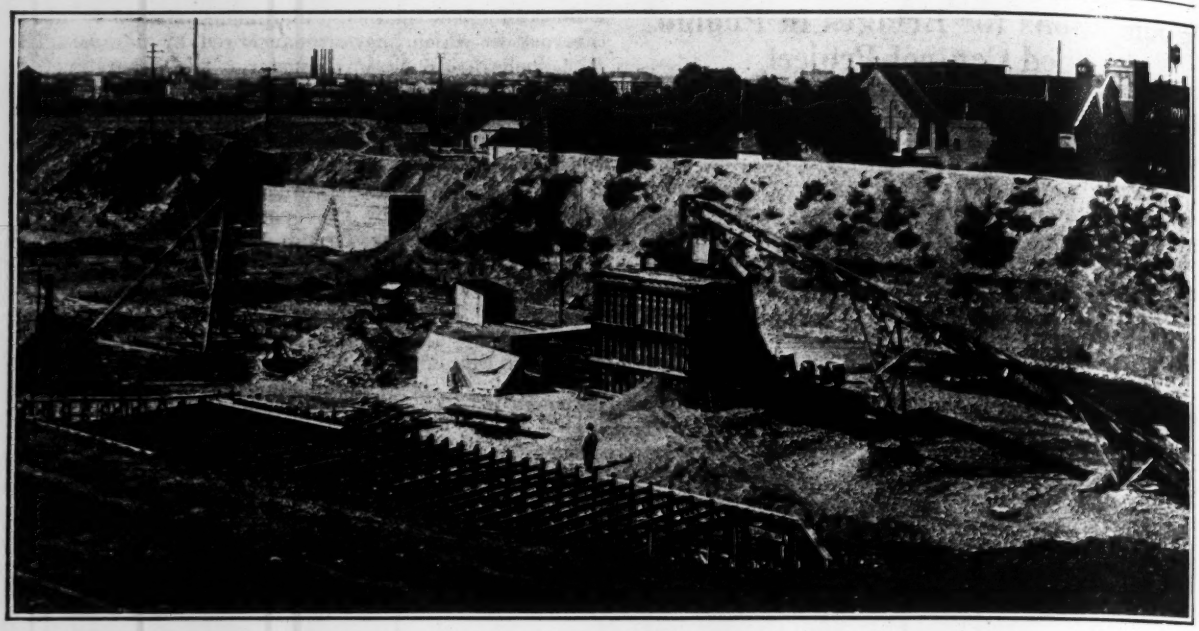
At the various sites the depth to rock ranges from 12 to 30 ft. In general the soil consists of coarse sand and gravel, which is underlaid with shale or slate. This rock is durable when sealed from the air. The shale disintegrates rapidly when exposed to the weather, but the slate, which occurs under the bridge foundations, is hard and more resistant. Ground water is usually found at a depth of from 5 to 10 ft. below the surface. In consequence of the large amount of wet work in an extremely porous gravel, the concrete caisson method was introduced to the Pueblo work by Salle and Salle, contractors, and followed by two other contractors for the railroad bridge foundation, each following to a large extent his own construction methods.

Since the Santa Fé Ave. highway bridge spans the entire top width of the channel, thus permitting the abutments to be placed within the body of the levees forming the channel banks and the entire slopes of both banks are here protected with a concrete revetment, it was possible to use cylinder piers. The piers, which are more economical than solid abutments, rise 50 ft. above the rock to which they are anchored by dowels. The ⅜-in. shells are 6 ft. in diameter. The superstructure crossing the channel at a skew of 30 deg., consists of a single riveted through truss span, 280 ft. between bearings. It weighs 375 tons and has a 28-ft. roadway and two 6-ft. concrete sidewalks.

Substructures of the railroad bridges on the main channel were built by the open caisson method. The lower Denver & Rio Grande-Western superstructure consists of two 176-ft. riveted through skew truss spans, weighing 887 tons. Both abutments are placed in the levee or back section and are thus protected by the concrete bank revetment. The single pier is located in the middle of the channel. The upper bridge of the same road, which is above the channel diversion, consists of four 100-ft. through plate girder spans weighing 197 tons each and carrying two tracks. Its piers and abutments were put in by the caisson method.

The Dry Creek bridge, which must act as a portion of the levee at flood peaks, is a four-track structure built entirely of reinforced concrete and has sufficient weight to counteract the buoyant effect of the water during a maximum stage. It contains 5,200 cu.yd. of concrete and consists of five 40-ft. spans supported on a heavy reinforced-concrete girder on each side as well as between each track. The outside girders are built up to levee grade, 9½ ft. above rail, and connect with levees at each corner of the bridge to exclude the water from the tracks and the city in case of extreme floods. Excavation for the four piers for the bridge was made to rock with a dragline.

Caisson Methods—The general method used in sinking all subsurface concrete for the railroad bridges, except the Dry Creek bridge, was to pour the concrete in wood forms set on the surface at the site of abutment or pier. The height was such that when sunk to rock the top would just exclude the surface material. When sunk the caisson was filled with concrete, the shell of the caisson forming part of the finished structure below ground. The caissons ranged in height from 14 to 22 ft. and with walls from 12 to 18 in. thick, beveled to a cutting edge along the bottom. A comparatively rich mix was used in the cutting edge. For cross-bracing old rails were used instead of reinforced-concrete struts or diaphragms as the rails made the caissons more flexible and better able to take the strains of unequal settlement.



ABUTMENTS AND PIER FOR LOWER RAILROAD BRIDGE

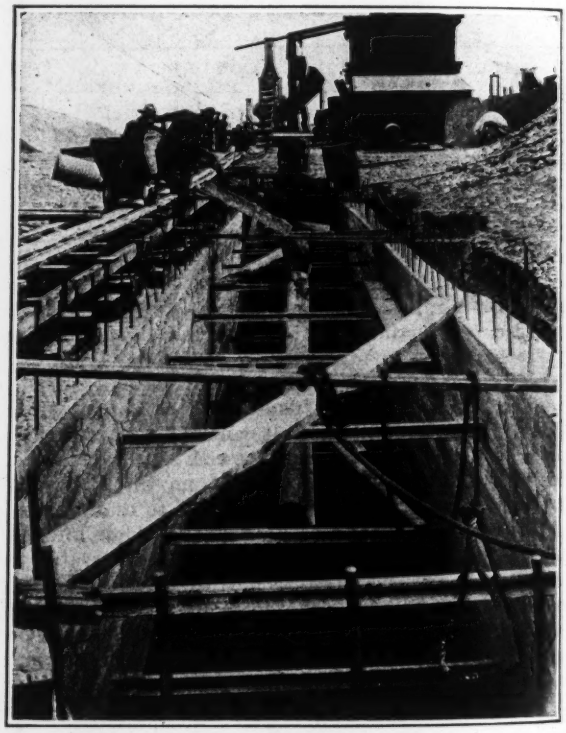
In foreground just over edge of channel bank is top of formwork for south abutment caisson. In the left center near the derrick is middle pier caisson sunk to rock and filled with concrete. Beyond is completed caisson for north abutment ready for sinking. Plant for preparation of aggregate from river bed materials in center.

Where a minor portion of the rock surface encountered by the cutting edge was found to be high it was blasted away to permit sinking to a level base on the rock. When minor portions were low, steel sheeting was driven to rock at an angle outward under the cutting edge and concrete poured up to the edge after the material had been removed. The sheeting was then pulled and a concrete bond poured in the triangular space in the section of the caisson making a vertical inside wall to rock.

Various methods were used to excavate the material from inside the caisson. In one case it was excavated entirely by hand by shoveling into dump buckets which were hoisted by an electrically-operated derrick. The contractor on this work believes that this method is as cheap as the use of machinery and gives better control of the sinking, reduces the stresses in the caisson and sinks it more accurately to line. In other cases the material was dug by hand from beneath the cutting edge and shoveled to the middle of the caisson, where it was picked up by clamshell or orangepeel buckets, the latter being found more satisfactory. Where little water is encountered, this method is probably more economical than hand excavation. The average rate of sinking, except under unfavorable conditions, was 1 ft. per shift.

Several methods were tried of taking care of the water while placing the concrete in the bottom of the caisson, but the most satisfactory was to form a sump at the lowest point of the rock foundation, and lead the water to this sump from the edges of the caisson through large old boiler tubes. By plugging the worst places around the edge with bags filled with concrete, practically all the water could be diverted through the tubes and the floor kept nearly dry. The sump was carried up as the concrete was placed in the caisson, until it was above the water level and pumping was no longer necessary. It was then filled by depositing the concrete through the quiet water with a tremie.

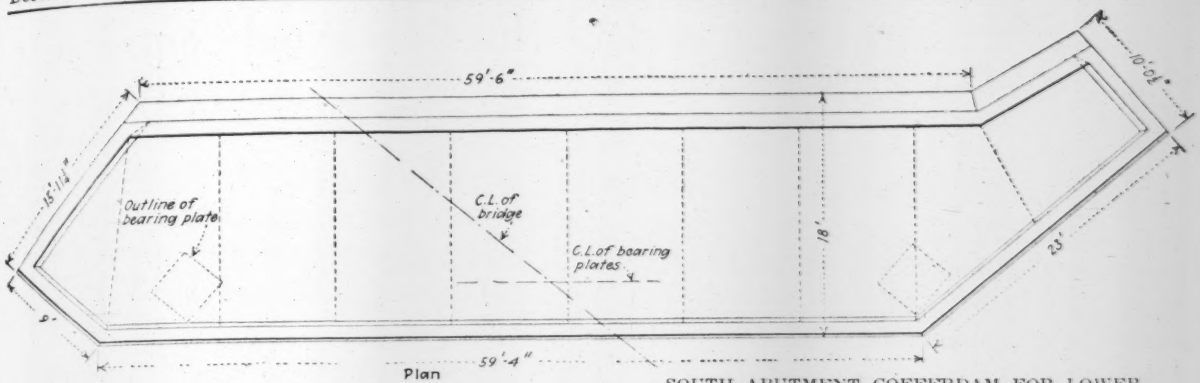
As the cost of electric power was low the pumps were operated continuously, even when only one shift was



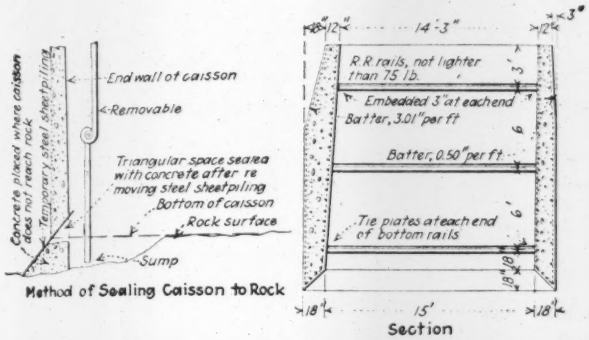
CENTER PIER CAISSON SUNK AND BEING FILLED

Old rails used as struts to resist lateral pressure against walls. Pump suction at far end leads to sump carried up with concrete until above ground water level.

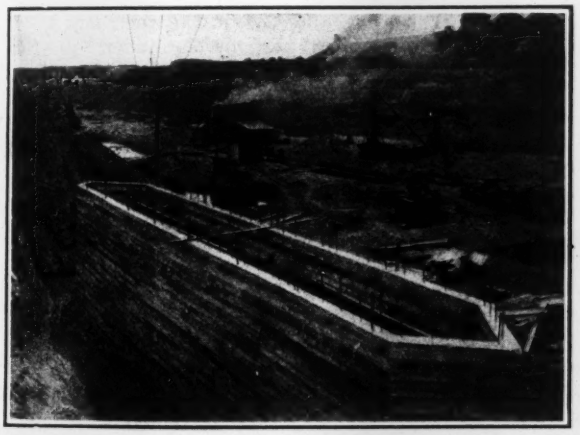
employed, the regulation being accomplished by a valve in the discharge pipe. One contractor used a canvas pipe in place of the ordinary wooden trough, maintain-



SOUTH ABUTMENT COFFERDAM FOR LOWER RAILROAD BRIDGE



ing that it paid for itself in keeping the job dry and preventing the water discharged by the pump from flowing back and carrying sand into the caisson. The excavation around the pump suction was kept somewhat in advance of the cutting edges to keep the material in the caisson free from water.



NORTH CAISSON FOR LOWER BRIDGE READY TO SINK

Caisson 18 ft. high is sunk by excavating from within with clamshell bucket and derrick. Concrete and aggregate plant in center of river has just completed filling center pier.

Because of the porous nature of most of the material encountered, pumping at one point drew down the water table of the surrounding area. Often it was possible, when one caisson was being pumped at a considerable depth, to excavate without pumping in adjacent caissons and in several cases a caisson was started in a hole excavated in the dry by teams to an elevation 8 to 12 ft. below normal water level. All caissons could be built on dry land except one pier in the upper bridge. This pier is located in the existing river channel and gravel was cast on the pier site to make an island.

In using open caissons, it is necessary to know the elevation of bed rock, otherwise the proper caisson might be either larger or smaller than contemplated and the bracing and reinforcement improperly proportioned. At Pueblo the rock elevation was determined by driving old rails with a pile hammer. In all cases the cassions were built with level bottoms but where major irregularities in the rock are likely to occur, it is felt that it would be advisable to determine the configuration of the rock and build the caisson to fit it.

Steel superstructure plans for the bridge were prepared by H. S. Crocker, consulting engineer of Denver. The caisson designs were made by D. W. Wood. All of the work for the Pueblo Conservancy District is directed by Barton M. Jones, assistant chief engineer, Dayton Morgan Engineering Co.

Duplicate Steel Pipe Lines for Bombay

DUPLICATE riveted steel water mains 55 miles long are being built from Lake Tansa to Bombay, India, to add 108 Imp. m.g.d. to the water supply of that city, which now uses some 58 Imp. m.g.d. The plates (⅜ in. thick, 7 ft. 4½ in. wide and 15 to 20 ft. long, according to the pipe diameter) are rolled, cut, planed at the edges and drilled for rivets at Middlesbrough, England, by Dorman, Long & Co., and are fabricated into sections 57½ ft. long at Muland, India, by Brathwaite & Co., of West Bromwich, Birmingham, England. For both shop and field riveting and calking pneumatic tools are used. The shop-fabricated sections of pipe are coated inside and out with a bituminous solution, states London *Surveyor* in a desription of the job in its issue of Oct. 24, by means of pneumatic point sprays. To transport the pipe from the shop to the pipe line 232 "specially designed bolster" railway cars are used. Cranes spanning the pipe line lift the pipe sections from the cars and lower them to position. Expansion joints are placed at intervals of 1,000 ft.

NATIVE INDIAN CALKING STEEL WATER PIPE WITH PNEUMATIC HAMMER

Sketch after half-tone in *The Surveyor*, London, England.

Drawing, Advertising and Letting Municipal Contracts

Lump-Sum and Other Types of Bids Compared—The Call for Bids, the Letting of Contracts and Reflections on Good and Bad Engineering

By J. N. Ambler
President, The Ambler Engineering Co., Richmond, Va.

This article is published for the engineer who is inexperienced in preparing and letting contracts for municipal work; also for anyone who wishes to know the viewpoint of an engineer with much experience and observation in the municipal field.—Editor.

A MUNICIPAL construction contract should be drawn to accomplish a specific piece of work with the maximum of efficiency and economy, and within the least practicable period of time. To this end, complete and definite plans and specifications are necessary. These should be prepared by an engineer thoroughly competent and experienced in the lines of work involved, and *solely* in the interests of the municipality, which, of course, demands the most high-minded and disinterested service on the part of the engineer.

To decide what type of contract will best meet the aims set forth, it may be well to sketch briefly some of the more salient features of the types of contract in use.

1. Lump-Sum Contract—From earliest times, the lump-sum contract has been the most popular, because it indicates in advance what the work would cost. When conditions are such that the costs of labor and materials may be predicted with reasonable certainty, during the period of the contract, this type is entirely practicable, and with the check of certain abuses (to be pointed out later) will doubtless continue to hold its present popularity.

2. Unit-Price Contract—When quantities are accurately known in advance of the contract, the unit-price type is practicable, but it is troublesome as to the comparison of bids. In this respect it offers little, if any, advantage over (1). However, there are circumstances where quantities are not known accurately in advance, as in the case of street improvements, when there has not been sufficient time for complete surveys and estimates, and it is certain the volume of work will grow, through petitions of citizens that work be done on additional streets. Sewer contracts, also, are particularly subject to changes, as to sizes, depths, amount of work done, etc. In such cases, this type is particularly applicable, being more flexible than (1).

3. Cost-Plus-a-Percentage Contract—Since the more the work may be made to cost the greater will be the contractor's profits, the cost-plus-a-percentage plan is clearly an invitation to bad management, inefficiency and graft. It is difficult to conceive of any set of circumstances, even under the conditions which prevailed during the world war, which would justify this type of contract.

4. Cost-Plus-a-Fixed-Sum Contract—Under this type, the contractor is assured of being paid actual cost, and also a fixed sum, which represents the profit for which he is willing to enlist the services of himself and his organization. This plan is superior to (3) in that it removes the incentive to make the work cost as much as possible. It is radically defective, however, in that it fails to supply sufficient incentive for efficiency in management and for economy in the purchase of materials and working equipment. Then, too, the determination of "cost" is difficult, particularly since there are various overhead expenses which may or may not be admissible.

5. Cost-Plus-a-Fixed-Sum, With Guaranteed Maximum—This type, like (4), removes the temptation to make the work cost too much, and also supplies an incentive to good management, the contractor having a chance of making a bonus, if his management is good, and of incurring a loss in case it is bad. The great danger of this type is that the maximum will be fixed too high, thus making work done under a contract of this kind cost more than if it had been done under (1) or (2). There is also the same difficulty in determining "cost" as in (3) and (4), though contract provisions may reduce this difficulty. This type would seem to offer no clear advantage over (1) and (2) except when conditions are so perturbed that it is impossible to predict, even a short time in advance, what the cost of labor and material will be. Under these circumstances contractors will bid on this type of contract when they would decline to bid on either (1) or (2).

Abuses—Among the more common abuses observed in applying types (1) and (2) is the tendency to let the contract to the "lowest responsible bidder," in utter disregard of his character, experience, financial ability, or any other kind of ability necessary to make the work a success. A private individual, or corporation, having no such fears of political scandal, retains the right, and acts upon it too, to let the contract upon that bid which, viewed from all angles, is to his, or its, best advantage. It would seem clear that a municipality should possess the same privilege, and it is its duty to exercise the privilege in the interest of the tax payers.

Another abuse in the handling of municipal contracts is the fumbling of a time limit. The bidder should, of course, be allowed to fix his own time limit within which he will guarantee to complete the work, and this time limit should be incorporated into the contract as a part of the essence thereof. Failure to complete the work within the time limit always causes damage, not only in the loss of interest on bonds, but also in loss of the advantages to be derived from the works, and often the loss of revenues or other special advantage which would have accrued had the work been completed on time. To these losses should be added the cost of additional engineering supervision, beyond the time limit of the contract. While it is nothing more than right that a proper amount of time be given to the contractor, for the completion of the work, it is also clear that if he fails to complete it within the time which has been guaranteed in the contract, he should bear at least a part of the damages which result.

The engineer cannot, of course, wholly prevent these abuses in American contract letting, yet he can do a great deal in the right direction by throwing his influence on the side of businesslike action and square deal-

ing, with a view to getting the best possible returns for the money expended, and *real economy* rather than apparent low first cost. To this end, let him accompany his plans and specifications with a sheet of information to bidders, which sets forth clearly all essential facts connected with the work, and how it will be conducted. This practice tends to produce confidence, and therefore reduces the heavy element of "insurance" often placed in a bid.

The sheet of information should plainly set forth that the experience of the bidder on similar work, his organization and equipment, as well as his financial standing, and reputation for having done honorable and successful work without controversy or litigation, will receive consideration, and that, in the making of an award, the right is expressly reserved to make the award upon that bid, which, in the opinion of the governing body, is, all things considered, to the best interest of the city.

With the phrasing of the aforementioned notice, there is no obligation whatever on the authorities to give any reason for their action, other than that the bid which was accepted was considered, from all angles, to be to the best interests of the city. Thus, the authorities are in a position where they may act exactly as they would in letting a private contract, and a most important advantage to the city has been gained.

Advertising for Bids—Every effort should be made to get the greatest competition between competent and reliable bidders, with the least practicable delay, and with a minimum of expense. To this end, the work should be advertised in one or more of the best known national technical journals, and the engineer should prepare the form of advertisement and his advice should be depended upon in the entire matter of advertising for bids.

If the advertisement is made too brief and meager, not giving the necessary information to prospective bidders, it may fail of its object. If too long, it will be at increased cost, without compensating advantage. It should be sufficiently long to permit concise statement of the character and magnitude of the work, the character and capacity of the machinery and equipment required, and it is also well to give the approximate quantities involved. The object of the advertisement is to enable the bidder to determine at a glance whether or not the work is of a character and size to interest him. If this is accomplished much correspondence and loss of time will be saved, and more bidders will be secured.

The advertisement should state the amount of the certified check to be required of the bidder—usually 5 per cent of the face of the bid. It should be plainly stated that this check will become a forfeit to the municipality if the contract is not entered upon and an indemnity bond executed promptly after the award. The advertisement should also set forth that an indemnity bond will be required of that bidder to whom the contract may be awarded. This bond is usually in a sum equal to from 25 to 50 per cent of the face of the bid, and is intended to protect the municipality against failure to perform all the provisions of the contract, of which the plans and specifications should be made a part, by adoption. It should be insisted upon that this bond be executed by some regularly incorporated bonding company, satisfactory to the municipality.

It is recommended that the engineer publish, with the plans and specifications, not only the sheet of information already alluded to, but also the full form of construction contract which will be required, this being provided with blank spaces for filling in the prices bid on the various items, as well as the time limit and the signatures.

The form of indemnity bond which will be required should also be published with the above. The usual form of indemnity bond, as written by the bonding companies, often allows of their re-financing a defaulted contractor and placing him back upon the work. In many cases this is highly objectionable, since by the time a contractor has defaulted he has generally been doing such unsatisfactory work that he has become an unacceptable person, in general, and is about the last man who could be found for the satisfactory completion of the work. Only in the event that the balance which would have been due to the first contractor is insufficient to pay for the completion of the work should the bonding company be called in, and then only to make up the deficit. It should be provided in the contract that, in case of default, the municipality reserves the right to employ other parties to finish the work as it sees fit. If, now, the bond is so written as to cover the carrying out of all the provisions of the contract (of which the above is one), the point is covered.

As to the time necessary for running the advertisements, the following suggestions are offered: The object to be accomplished is that bidders may see the advertisement several times and have sufficient time to get prices on all materials and equipment and to prepare their bids. Ordinarily two weeks is sufficient for the actual running of the advertisement, with three weeks as a maximum, in the case of large or intricate work. The date set for receiving bids should be from four to five days after the last weekly advertisement has appeared, should not fall on Saturday or Monday, and the hour selected for closing bids should be set with reference to the convenience of the authorities, with due respect to the arrival of trains.

The advertisement for bids should designate the place where plans and specifications may be examined. In the case of important work several such places may be designated, one of them, in all cases, being the office of the city clerk, and often that of the engineer as well.

It is also necessary to provide for the furnishing of copies of plans and specifications to prospective bidders, for within a few days after the advertisement has appeared requests for plans and specifications from parties scattered over the entire country will begin pouring in. Every possible effort should be made to facilitate the efforts of bona fine bidders, to get the plans, specifications and all other proper information. Every obstacle should be placed in the path of those who desire plans, etc., for reasons not connected with the work, or those whose possession of them would be of no value to the municipality. As a rule, the engineer is able to cull these requests, and to send plans to those parties only who should have them. Most engineers require a deposit of an amount stated in the advertisement before mailing out the plans, this deposit being returned upon the return of the plans in good condition.

The following suggestion for handling the matter of sending out sets of plans and specifications is offered. Let the engineer state, in the advertisement for bids, that a copy of the plans and specifications may be had from the person designated on receipt of a check in the

sum of $....., and that this check will be returned only in case a bona fide bid has been submitted, and the plans, etc., returned in good condition, before the date set for opening bids. Evidently real bidders will thus be in exactly the same position that they were under the old plan, for if they bid they get their checks back. Those who do not intend to bid will not get their checks back, and this fact is relied upon to prevent triflers from causing loss of time and money to anyone. If their curiosity is strong enough to warrant their buying the plans outright, but little harm has been done.

Receiving and Considering Bids—We will now assume that the plans and specifications have been sent out, more or less widely, that real bidders have visited the site of the works, and sought information from the engineer and the city authorities, obtained local prices on labor, materials, etc., and that the day set for receiving bids draws nigh. The engineer should proceed to the site of the works, and be present for a day previous to receiving bids. This is to clear up matters which may not be clear to the bidders, to explain the construction which will be placed upon various matters in the specifications and contract, so see that material and machinery men are put in touch with the general contractors, and that uniform bidding blanks are distributed to all bidders. If the engineer is a reasonable man, and one thoroughly experienced in the handling of municipal contracts, his presence and assistance will be of great value to the municipality, as well as to the bidders. He should be able, not only to explain misunderstood matters to the bidders, but also to inspire confidence that they will get a businesslike and square deal, thus removing the element of "insurance" in their bids, which would undoubtedly be present otherwise.

Since, as has already been pointed out, the element of time required for construction is a most important matter, it should be reflected in some just and proper way in the bidding, so that bids may be compared upon a "time of completion" basis, as well as upon a price basis. A bid of $200,000 to complete a piece of work within 18 months is not as good, by $6,000 (interest), as a bid to complete it within 12 months, at the same price, which fact should be recognized. In this specific case, bids may be compared upon the basis of $1,000 per month, for the difference of time required by them for completion. For any given case, the basis upon which time is to be figured, in comparing bids, should be plainly set forth in the instructions to bidders.

All bids should be presented, under seal, to the Mayor, or other official designated to receive them, and none should be opened until all are opened. Each bid should be read out in public, in the presence of all the bidders, and opportunity should be afforded them to tabulate the bids, if they so desire. The engineer and the city clerk should also tabulate the bids as they are read out, so that each may retain a copy. It is then desirable, and proper, that the board go into executive session with the engineer and the attorney, for the purpose of canvassing and discussing the bids.

Awarding the Contract—It is most desirable, whenever possible, that a single firm should have the entire contract, thus preventing any division of responsibility. It sometimes happens that there is no single bid covering the entire work, and even in those cases where one or more bids are submitted which cover all items of the work, the acceptance of any entire bid would cost the municipality more than if the work were split up by items. It is then in order to consider splitting the work among the bidders according to the most favorable bids by items, making as few bidders in any group of bids, to cover the whole, as is possible. This grouping should not be done against the will of those bidders involved in it, or great injustice may result. Usually some grouping can be found which will cover the entire work, at less cost than any single bid, and upon which all parties interested are able to agree.

In many cases the advantages of unbroken responsibility may still be secured by having the bidders on minor parts of the work transfer their bid from the city to that bidder whose bid on the larger part of the work is accepted, thus allowing of having a single contract and one bond. Of course, this arrangement can only be made with the consent of the bidder whose bid is to be transferred, and this is often objected to, because of the greater responsibility of the city in making payments direct than the contractor could offer to a sub-contractor. If the above arrangement is impossible of accomplishment, a separate contract and bond will have to be executed for each bidder involved.

If Bids Are Unsatisfactory—The fact that there are but few bids, or possibly only a single bid, is unfavorable, but if the bids which are received are not too high, this need not cause the rejection of bids, with the attendant disadvantages of a re-letting, unless the state laws make it mandatory that there be more than one bid before a contract can be let.

When bidders have all deliberately bid too high, or those on some items have done so, it would not seem that they were entitled to much consideration, and it remains for the municipality to protect its own interests, and to proceed in a manner to its own best advantage. It is entirely proper, though in no way obligatory, to allow them to reduce their bids, if they so desire, or to allow any one or more of them to do so, in case some refuse. In no case, however, should this be allowed without affording an equal chance to all. The new bids should be submitted in writing, and considered in the usual manner, but nothing partaking of the nature of an auction should be held, as such adds nothing to the reputation of the city. Parties who have deliberately bid too high have no just cause for complaining if the city is forced to follow the procedure outlined above.

It occasionally happens that the bids are above the appropriation for the work in hand, or even above the means of the city. In this case every effort should be made to bring the interests of the city and of the bidders together, so that the contract may be let. The rejection of bids is always unfortunate, since at least a month will be lost before new bids may be had, through another regular letting, there will be interest on the bonds, expense of new advertising and time lost from the construction season. Besides, it is not at all certain that the new bids will be even as low as the former ones. For the above reasons, a letting should never be declared "off" until every possible effort has been exhausted to get together. If the engineer is thoroughly experienced in construction costs, and in handling matters of finance, he will have many ways of exit from so unfortunate a situation, and if his efforts are met in a proper spirit by the bidders and by the city, it is safe to say that very few cases will have to be set down as total failures, although there will be some.

Eliminate Risky Work from Lump-Sum Bidding—It is bad policy to require a lump-sum bid on an entire piece of work when the work involves serious difficulties and uncertainties of such a nature that their extent cannot be predicted in advance. It is not only much fairer, but also better business policy, to have the lump-sum bids cover only that part of the work which is capable of being made definite, and to class all else as extra work, to be paid for under provisions of the contract covering such. Under this plan, the bidder, knowing that he is protected against matters wherein lie difficulties, which neither he nor anyone else can predict, either in amount or character, will naturally feel enough confidence to give his best bid on the definite part, and rely on the clause covering extra work to protect him.

Municipal Square Dealing—Too much stress cannot be laid upon the importance of a municipality being meticulously careful to deal squarely with a contractor at all points. Any other course is not only morally wrong, but, since contractors, as a class, are very necessary factors of a city's business, and will be needed again in the future, it is the poorest imaginable policy. It is certainly the folly of ignorance to assume that inasmuch as all contractors are "fleecing the public," therefore it is perfectly in order to place any burden which may be desired upon those who happen to be for the time within one's power. As a matter of fact, the profits on contract work usually are far smaller than they are generally assumed to be, and smaller than those to be expected in many lines of business.

Often a few unjust rulings, which place burdens where they do not justly belong, will turn the balance from a profit to a loss on the work. It is just as necessary that a municipality preserve its credit and good name, as it is for an individual, firm, or corporation of any kind, expecting to stay in business. If a municipality has earned the reputation of being hard and unjust with contractors, and the fact becomes widely known to all members of the contracting business, that city will undoubtedly pay more on all subsequent work than it ever saved by injustice on a preceding contract.

Bad Engineering and Arbitrariness—Another element which causes trouble in contract work and which, therefore, should be adverted to in this connection, is bad engineering. Under this head should be included not only incompetency in preparation of the plans and specifications but also inexperience and incompetency (its concomitant) in handling the work of construction. Other elements may be added, as a reputation for hair-splitting, lack of conciliatory and co-operative attitude, as well as an overbearing and haughty manner, and unwillingness to discuss with a contractor the difficulties which arise in any work and the best methods of meeting them.

When bidders realize, either through their own experiences or those of their colleagues, that the engineer who will have charge of the work is not all that he should be, or that he is inexperienced in handling work and in dealing with contractors, it can be safely assumed that a goodly percentage of the bids submitted will consist of "insurance," with the result that the city pays more than it should for the work and will probably not get what it is paying for.

It is perfectly possible to design a structure of such a nature that its construction is impracticable, if not impossible. Very commonly designs of various works do not seem to have recognized the best and most practicable methods of economic construction. While it may be entirely practicable to build such works yet lack of the above recognition often greatly enhances the cost, without compensating advantage. Frequently but slight changes in the plans and specifications would allow an equally good result at much less cost. In working out plans for any undertaking, the engineer should be able to place himself in the position of a contractor, and ask himself how he would build the work, if he had the contract. Such a review of plans before release will always be found profitable.

All these matters go to show that incompetent and inexperienced engineering can add far more to the cost of the work than can possibly be saved by the cheapness at which it may be offered. The very best course which a municipality can pursue, from the standpoint of economy and safety, is to invest in the services of a thoroughly experienced and competent engineer, one who is broad-minded and of unquestioned integrity. There can be no doubt that such a one will require the most complete compliance with the plans, specifications and terms of contract, and that he will be able to meet unforeseen difficulties as they arise, settling them in the spirit of giving the squarest possible deal to every one concerned in the work. Better still, he will be able to obtain the results desired, and without injury to the reputation of the city by which he is employed.

Adhesion of Gypsum Plaster to Concrete

From a Technical Bulletin of the U. S. Bureau of Standards.

IN A REPORT published in the *Proceedings* of the American Society for Testing Materials one of the conclusions reached was that a gypsum plaster could be made which would have under the same conditions approximately the same co-efficient of expansion as a concrete, provided the characteristics of the concrete were sufficiently studied. As this work was conducted upon gypsum obtained in the open market, the question arose as to the effect of age upon the volumetric properties of gypsum plasters. At the request of the Gypsum Committee of the American Society for Testing Materials this investigation was reopened by the Bureau to answer this question.

Samples of freshly calcined material were obtained from mills located in various parts of the country, together with the sand used in different localities. From these materials test specimens were made, using the sand and gypsum which might be found in a given locality. These were tested for expansion, using the freshly calcined material, and there has recently been completed a series in which the calcined gypsum has been exposed to the air for a six months period. In each case the gypsum was analyzed to determine its composition. The results of this work bring out the following:

1. Freshly calcined gypsum shows a loss in $CaSO_4.\frac{1}{2}H_2O$ content on exposure.

2. Specimens made from aged plaster show a greater expansion and contraction with humidity changes than with freshly calcined material.

3. With a specific gypsum and a specific sand a gypsum mix can be made having approximately the same expansion under similar conditions as a concrete, provided a sufficient amount of data is available upon the expansion characteristics of the gypsum with the sand and the concrete in question.

4. In some cases a manufacturer has never experienced a failure of bond between gypsum plaster and concrete. This may be attributed to the composition of the calcined gypsum produced and that it was used unknowingly with such a proportion of the proper sand as to give a plaster which behaved similarly to the concrete with respect to expansion, when subjected to the same conditions.

High Early-Strength Portland Cements in Germany

Development of Standard Portlands That Approximate Early Strengths of the New Alumina Cements

By Dr. Gustave Haegermann
Director, German Portland Cement Association Laboratory

A paper presented at the Annual Meeting of the Portland Cement Association, Chicago, Nov. 18, 1924.

IN THE hardening of the several hydraulic cements, considerable differences are observed. The extreme limits of the hardening process are defined by hydraulic lime and high alumina cement. Hydraulic limes show slow but steadily increasing degrees of hardening, whereas in high alumina cement, or alcement, the early strength is rapidly reached within the first few days; subsequently the increase is very slight. Between these limits there are manifold transitional stages. Ordinary portland cement stands approximately half way between these limits. It shows a comparatively poor early hardening and a permanent subsequent hardening. The differences in the state of hardening may be clearly seen in the graphic representation.

Properties of Alcements—The setting is normal. The early compressive strength is very high; the tensile strength compared with the compressive strength is low. At later periods tests very often show under water a loss of strength. Let me point to the investigations of P. H. Bates, who appears to believe from his observations on calcic aluminates that these do not equal the resistance of portland cement under water. An advantage of alcement is its high resistance to sea water and water containing gypsum. It does not appear to be resistant to alkali sulphates; breaking up of the mortar does not occur, it is true, but the texture is loosened by the substitution of calcic aluminates with alkali sulphates, gypsum and soluble alkali, aluminates being formed.

High alumina cement reacts with acids and alcoholic liquids in a similar way as portland cement with oil; the reaction on alcements is deteriorating. It is a decided disadvantage of alcement, however, that it must not be mixed or augmented with other hydraulic cements, the setting being thereby considerably accelerated and the strength greatly reduced. The alcement should not be superimposed on concrete of portland cement, as it has been proved that disintegration takes place. Alcement shrinks more in the open air than does portland cement; its elasticity, however, is greater than that of portland cement.

The scarcity of bauxite and the present high price of high alumina cement is adverse to its introduction. The price is about two and a half times as high as that of portland cement. It is quite possible that at some future date the price may be lowered, if we should be successful in manufacturing the alcements in a continuous process. But the scarcity of raw materials remains and even if we should succeed in enriching the clays with alumina, one should not forget that the treatment might considerably increase the cost of the raw material. As far as the development can be foreseen it would appear as if alcement can be satisfactorily used in water containing gypsum and in sea water. However, with structures requiring high early strength its price would militate against its general application.

High Early Strength Portland Cement—The high early strength portland cement will in future be of increasing importance to the portland cement industry. It is not the mere question of producing high-grade cements, but rather the maintaining of the reputation of portland cement as the best of its class. For this reason it is a result highly to be desired that the strength and the process of hardening be not inferior to those of alcements at the early periods. Although these high-grade portland cements are in the very beginning of their course of development we have the feeling that the goal will presumably be reached within due time. Great advances have already been made.

Historical Survey—About twenty years ago certain German cement-works had already produced high-grade cements under various names, such as Selector cement, Rotary Kiln cement, etc. They were at that time used in structures requiring great strength. In the year 1913 at the suggestion of the Austrian chief railway engineer, M. Spindel, investigations were inaugurated in the cement works of Lorvens with a view to producing high early strength portland cement. These cements found practical application in the construction of bridges, tunnels and so forth. The results were satisfactory and in consequence of publications by the aforementioned chief engineer, several Austrian and Swiss works undertook the manufacture of such cements. Cement works in other countries followed.

For economic reasons the manufacture of these cements could not be undertaken in Germany before 1924. In the first quarter of this year only two factories began manufacturing. Later on fifteen other works followed. The value of such cements has not been fully realized, owing to the fluctuations in Germany's economic conditions. In the summer of this year overproduction occurred in consequence of the severe restrictions in the building market for want of capital. Things have somewhat improved since September and it is interesting to see that the demand for high early strength cements has increased as against ordinary portland cement.

COMPARATIVE TESTS OF ORDINARY PORTLAND, HIGH EARLY-STRENGTH PORTLAND AND ALUMINA CEMENTS

	Time of Set — Vicat Needle Initial H M	Time of Set — Vicat Needle Final H M	Fineness Residue 180 Sieve, %	Tensile Strength 1:3 Briq. Kg. per Sq. Cm. 2d.	3d.	7d.	28d.	Compressive Str. 1:3 Mortar Kg. per Sq. Cm. 1d	2d	3d	7d	28d
German standards for portland cement	1—			....	....	12	20	...			120	200
Average ordinary German portland	3—	7—10	14	....	....	21.4	27.5	...	113	..	234	335
Average high early strength cement	3—	7—	2–6	....	29.0	31.7	35.6	...	....	299	408	511
High early strength cement—A	2—55	5—50	3.1	27.2	31.2	36.3	38.2	...	232	302	430	598
High early strength cement—B	1—45	5—30	6.2	....	....	31.8	33.4	...	298	383	451	589
High alumina (ciment fondu)	4—	7—	5.8	24.7	28.7	31.2	28.2	424	452	501	521	608

Strength Tests—Prof. Ruth has made tests with high-grade cement with beams made of soft and viscous concrete mixed in the proportion of one to five and one to six. These tests proved that according to the conditions of mixing and the amount of water applied, in 3 to 5 days the safety point in loading demanded for these beams was more than reached.

A test flooring, consisting of two series of beams, was uncovered after 47 hours, and in 48 hours loaded to three times the efficient capacity without rupture.

On a ribbed reinforced-concrete roof with span 25 ft. in width—mixture 1:5.5—the forms were removed after a period of four days and loaded temporarily with double the capacity. On a foundation, made of concrete in the proportion of 1:3.2 at the bottom and 1:2½:1½ at the top, a ball mill was installed after the concrete had been allowed to set for four days, and after six days the mill was put in operation. Concrete piles were driven in the soil after 8 days.

From expert statements of several cement works it is shown that artificial stone products were ready for shipment in the shortest time imaginable. Concrete roads were open to traffic in half the usual time. Tamped concrete pipe were transported in three days time and immediately laid. Other economies may be effected because of the rapidity with which forms may be removed and used over again.

The tests shown in the table give some comparative results on different cements tested in accordance with the German specifications and tests for portland cement.

Manufacture of High-Grade Portland Cement—The raw materials are the same as those used in ordinary portland cement. The composition is so selected that the cements have a high lime cementation index. This index is according to the formula of Newberry; 0.99.

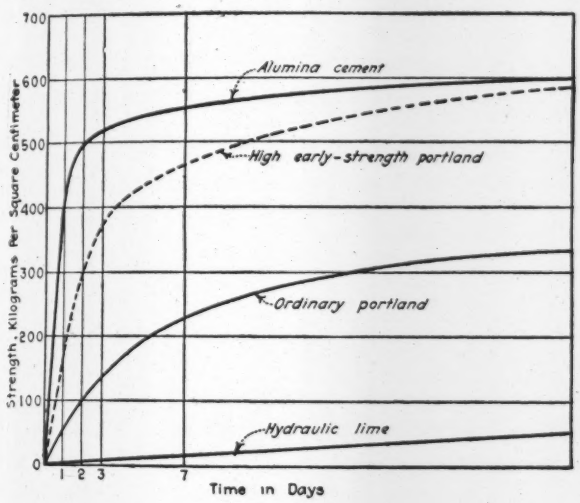
Very often small quantities (1 per cent or more) of iron ores or calcined iron pyrites are added to the raw material

in order to facilitate sintering. This addition increases the volumetric stability.

The composition of the raw mass must vary little; in well organized works they fluctuate between + or — 0.1 per cent.

The raw mix or the slurry must be carefully treated. It is absolutely necessary to secure the finest pulverization and intimate admixture. The fineness of the material when ground fluctuates with the raw material used. Pure limestone and clay must be ground more finely than marl which in its very nature is nearly of the same composition as required for portland cement. It is thus impossible to give definite figures for fineness. They fluctuate in the dry process by roughly 10 per cent on a 180 sieve and in the wet process by about 6 per cent with the same sieve. The admixing must be so conducted as to produce a homogeneous mass whichever of the processes of manufacture is employed.

The clinker must be well burned but not smelted. Tests have proved that by the smelting of the mixture of the raw materials, under most favorable circumstances, the results



COMPARATIVE STRENGTH CURVES OF VARIOUS CEMENTS

are sometimes the same—but in most cases the results are below the usual strength of hard burned clinker.

It is advisable to use coal comparatively free of ash; coal with a relatively large percentage of ash produces a material of less value. Firing with oil is highly recommended.

A fine grinding of the cement is of very great importance for high early strengths. In the setting of portland cement the reaction is, from a purely physical standpoint, a reaction between the surfaces of the particles. We know that when treating portland cement with water only the surfaces of the nucleus remain intact—or as Michaelis explains, it is mummified by a coating of gel. Thus if we augment the total surface of the clinker particles to take part in the reaction, e. g., the energy stored up in the clinker is more quickly exerted. High early strength portland cements are ground at present so that 2-6 per cent remains on a sieve of 4900 mesh and 8-13 per cent on a sieve of 10,000 mesh. The usual grade of the American portland cements has a residue of 18-20 per cent on the No. 200 sieve.

We see that the high-grade portland cements are far more finely graded. Fine pulverization it is true often produces great difficulties. The desired result is not always attained by reducing the charge. It has often been found that in tube mills and compound mills grinding is only possible up to a certain limit. Small scales are formed that cake together as it were, and these agglomerations prevent further division. In fact the less the charge the greater these agglomerations.

What mills are the most profitable and what should be the character of the pulverizing bodies in the fine grinding chamber? Germany tends to prefer compound mills made up of 2 or 3 chambers of considerable length, which preferably should be constructed several meters longer than at present and equipped with compound mills with air separators to take away the finest particles.

The last chamber contains small flint stones for advantage as grinding media; steel sections as long and as thick as a finger joint or punchings from rivet holes are used. These media have been successfully employed to prevent scaling.

In other works the pulverized material of ordinary fineness is re-treated in a mill filled with the above mentioned steel bits and punchings. Also this method of pulverization has been extraordinarily favorable.

Tube mills with air separators have also been successfully employed.

Finally let us turn to the production of fine pulverized material by means of air separation. The ordinary grinding product passes through air separators that screen off the finest particles. This fraction represents high early strength portland cement and the coarse fractions the ordinary portland cement. This method of processing is, I think, not a very profitable one. It stands to reason that in this case nothing but well burned clinker may be used. But in screening of the finest material by means of air separators of course the lightest particles are screened off. It happens that the slag surrounding the clinker and the soft burned, badly sintered clinker, namely, well sintered externally but imperfectly internally, is also screened off and deteriorates the product—nevertheless it has been proved that this method of processing also yields good results.

With regard to economic efficiency of the different mill systems no accurate figures are at our disposal. It goes without saying that the output in fine grinding diminishes. The fine grinding should not be carried further than economic and technical occasions allow. It is the task of the manufacturer to provide mills that fulfill these requirements. For easy grinding and reduction of grinding expenses, it is essential that the clinker should be stored for a longer or shorter period—a fact well known to milling operators.

As a rule about 3 per cent of gypsum equal to 1.26 per cent SO_3 should be added after one is obliged to take more gypsum, some of the works adding as much as 4.0 per cent gypsum equal to 2.5 per cent SO_3. The American standards require not more than 2.0 per cent SO_3. On reflecting that in finer grinding a considerably larger portion of clinker enters into immediate reaction, it is not surprising that more gypsum should be added which produces no bad results. Most of the European countries permit the addition of 2.5 per cent SO_3 and no ill effects have ensued. Just the contrary, small quantities of gypsum increase the strength. It is only when more than 5.5 per cent gypsum is added that disintegration takes place.

Finer grinding of cement necessitates an increased volume of water, this amount added reaching as high as 30 per cent.

Tests—In testing these cements the temperature must be carefully controlled. It is just the initial temperature that exercises great influence on the early strength. An interval of 5 deg. C., for instance 15 to 20 deg. C., lowers the strength by 10 per cent after a two days test; in three days time the difference is somewhat smaller, and after 7 to 28 days the difference almost disappears.

Summary—We stand at the beginning of the development of the high early strength cements. What has so far been gained is satisfactory, but I believe that it will be possible to increase the energy effect during the first few days of hardening. It is here that we find the most urgent problems touching the portland cement industry. The high early strengths of the high alumina cement have not yet been fully reached, but the tensile strengths have been already surpassed.

The scarcity of raw material (bauxite), the present roundabout method of production and especially the reaction on other hydraulic cements, militates against a general introduction of alcement in building construction if high early strength alone is considered, portland cement being superior in this regard. On the other hand the application of alcement for structures in water containing gypsum and in sea water will be much extended.

Removal of Capillary Moisture in Highway Subgrades

Tests Show Drain Tile Ineffective—Coarse Layers Check Rise of Moisture in Fine Soils—Sand Most Effective Agent

By Charles M. Upham and H. F. Janda

State Highway Engineer, North Carolina Highway Commission — Associate Professor of Highway Engineering, University of North Carolina

ONE OF the first requirements for the construction of a durable highway is to have a well drained subgrade and one that will remain well drained at all times after construction. Moisture in soils may be divided into two parts. That which can be removed by the action of gravity is called gravitational moisture. The second part of the moisture content is the capillary moisture, or that part which will be retained, in the case of a moist material, or drawn up in case of dry material by capillary action. General gravitational moisture may be removed by placing tile drains or any porous materials at intervals sufficiently frequent so that the water in seeking a common level may not have to percolate too great a distance through the soil to reach the drain. The removal of capillary moisture is a different problem.

The phenomenon of capillary rise is relatively simple. Briefly, it is that if water, or any fluid, is allowed to enter the bottom of a tube having a small passage-way, a force of attraction is exerted between the liquid and the sides of the tube which will tend to cause the liquid to rise inside the tube above the static level of the liquid outside, and this height of rise will vary in inverse proportion to the internal diameter of the tube, other things remaining the same. In the case of capillary action in soils, no uniform conditions, such as are present in tubes, exist. Consequently the action of capillary moisture in soils is susceptible of experimental treatment only. It is evident that in the case of some types of fine material such as plastic clay, the spaces which combine to form capillary passages are extremely minute, and a great height of capillary rise might be expected. This has been found experimentally to be true, heights of rise varying from 2 to 5 ft. having been reported.

Statement of Problem—The problem confronting the experimenters was to determine whether or not drain tile would remove capillary moisture from soils.

The method of attacking this problem was based on two principles. One was to determine whether the tile reduced the height of rise of the capillary moisture, and the other was to determine whether they reduced the amount of moisture.

The principle of determining the height of rise of the capillary moisture is shown by Fig. 1. This method depends upon the fact that water containing an electrolyte is a better conductor of electricity than plain water or dry soil. The contact at the bottom of the container and a brass rod plunged downward from the surface was connected in series with a battery of constant voltage and an ammeter. By observing the depth of the point of the rod and reading the current transmitted, a curve of the general form of Fig. 1 was plotted. The height of rise is shown as the point of B.

The water containing a 2 per cent salt solution was introduced into a watertight box 12 ft. long, 3 ft. wide and 3 ft. high. Holes 2 in. in diameter were bored through one side of the box and plugged with stoppers until the completion of the test, when the plugs were removed and a soil auger was used for securing soil samples. The water level was held at a constant height and allowed to stand in contact with the soil in the box for about four weeks. A 4-in. drain tile laid on a slope of ¼ in. to the foot was placed in one half of the box, the other half containing no drain pipe. The invert of the outlet pipe was set 12 in. above the bottom of the box. The bottom of the box was filled with crushed stone to the depth of 2 in. to insure uniform distribution of the incoming water.

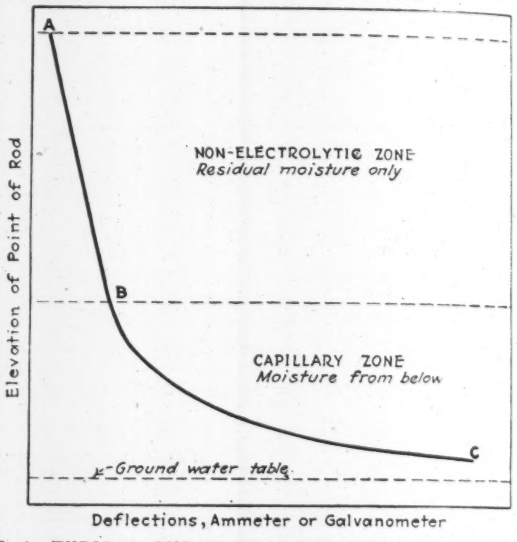


FIG. 1—TYPICAL CURVE SHOWING SOIL CONDUCTIVITY

Several soils, such as clay, sand-clay, top soil, etc., were tried and the following conclusions were reached:

1. That drain tile are of no direct value in removing or preventing the rise of purely capillary moisture.

2. That the percentage of capillary moisture is reduced as the elevation of the subgrade above the water table is increased. Therefore, a tile drain might reduce the percentage of capillary moisture by lowering the water table.

3. That the percentage of capillary moisture may be reduced by evaporation in connection with horizontal capillary movement, or by a reverse process it might be increased. Therefore, good drainage at the edge of a hard-surfaced road will assist in preventing capillary moisture under the pavement itself.

Since drain tile were found not to be effective in removing capillary moisture, a method of preventing the rise of such moisture was next investigated. The object of this series of tests was to establish conclusions as to the value of coarse layers (non-capillary) in preventing capillary action, and so far as possible, determine what non-capillary materials would be the most suitable for this purpose.

As a preliminary test, ten samples were prepared and run, using as many arrangements. The ten containers, each consisting of two lengths of 6-in. tile, were set on end. The water supply was a flat metal tank 4 in. deep in which the lower ends of the pipe were placed. The water contained a 2 per cent solution of salt. Sampling was accomplished by removing the top length of tile and digging out the soil to the desired depth.

The regular tests used the large box, which has been described, with slight changes. A bulkhead was placed across the box and formed two compartments. In one, no coarse layer was used, while in the other a 6-in. layer of non-capillary material was placed. The water containing salt was allowed to rise into the two compartments to a definite level and held in this position for four weeks. The soil was then sampled as described in previous paragraphs. The conclusions were:

1. That a layer of coarse, non-capillary material is an effective agent in preventing the rise of capillary moisture. (See Fig. 3.)

2. That some materials are more effective than others.

3. That sand seems to be the most effective agent in preventing capillary action. This is probably due to the fact that the particles are large enough to prevent capillary action, while the interstices are not sufficiently large to allow the fine capillary material to enter and act as a wick to pass the moisture through the layer.

Practical Application—The stabilizing of the subgrade of a highway is an important problem, and is one that needs more careful attention. Many soils with a low bearing power, due to a high moisture content, have been treated with tile drains with no success. In other cases the tile drains have given the desired results. This condition is due to the lack of appreciation of the fact that the moisture in one case has been of a capillary nature, while in the other is has been gravitational moisture.

Placing a layer of non-capillary material in soft, spongy soil will prevent the capillary moisture from rising from the subsoil and thus increase the bearing power of the subgrade. This method of stabilizing the subgrade is particularly applicable in cuts where soils containing large amounts of capillary moisture are commonly encountered.

There is no set remedy to apply to all cases. Tile drains can be used advantageously where the moisture

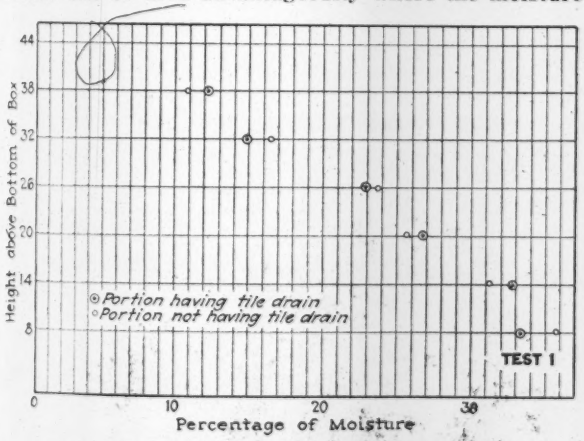


FIG. 2—EFFECT OF DRAIN TILE IN REMOVING CAPILLARY MOISTURE

is of the gravitational nature and where the tile are located well below the water table so that a positive head of water on the tile is present. Where the moisture is capillary, tile drains are not effective and the highway engineer must resort to other preventive measures such as the coarse, non-capillary materials.

These tests were conducted as joint research work between the State Highway Commission of North Carolina and the School of Engineering of the University of North Carolina. The work was started in

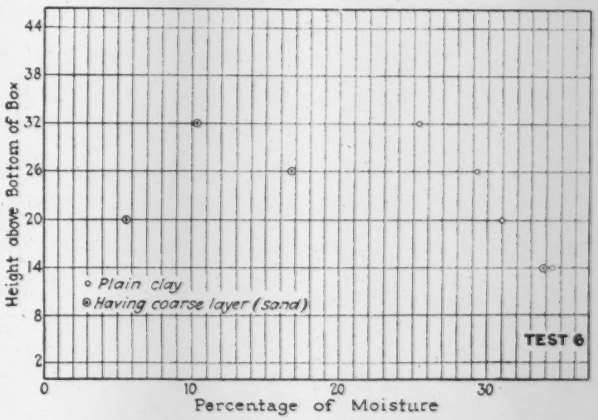
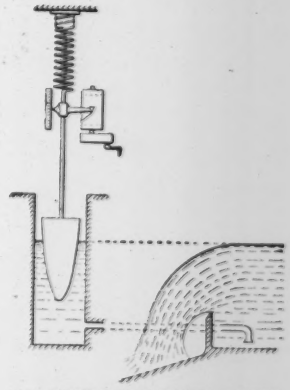


FIG. 3—EFFECT OF COARSE LAYER IN CHECKING CAPILLARY RISE

December, 1921, and continued for about eighteen months. Roy J. Morton, highway research fellow of the School of Engineering, was assigned to this problem under the direct supervision of the writers.

Autographic Hydraulic Volume Gage

A RECENTLY developed instrument for producing autographic records of hydraulic quantities that depend upon water stage, as the flow in a channel or the volume stored in a reservoir, makes an ingenious application of a simple principle. The instrument is actuated by a heavy plunger which dips into the water in the channel or reservoir to be gaged and is suspended from a stiff spring. As the water level changes, the buoyancy of the plunger changes according to the change in immersed volume, and the spring lengthens cr shortens correspondingly. The movement of the spring is used to actuate the recording pin of the instrument. By shaping the profile of the plunger to suit the particular case, the pin movement can be made proportional to any desired function of the water stage. A cylindrical plunger would draw a curve of water stage, while a plunger growing larger toward the top, like the one shown in the sketch, would give a record of a quantity increasing more rapidly than the stage. The water volume in a reservoir may be accurately represented if the plunger is made of irregular profile corresponding to the relation between storage volume and reservoir depth.



VOLUME RECORDER ACTUATED BY VARIABLE SECTION PLUNGER

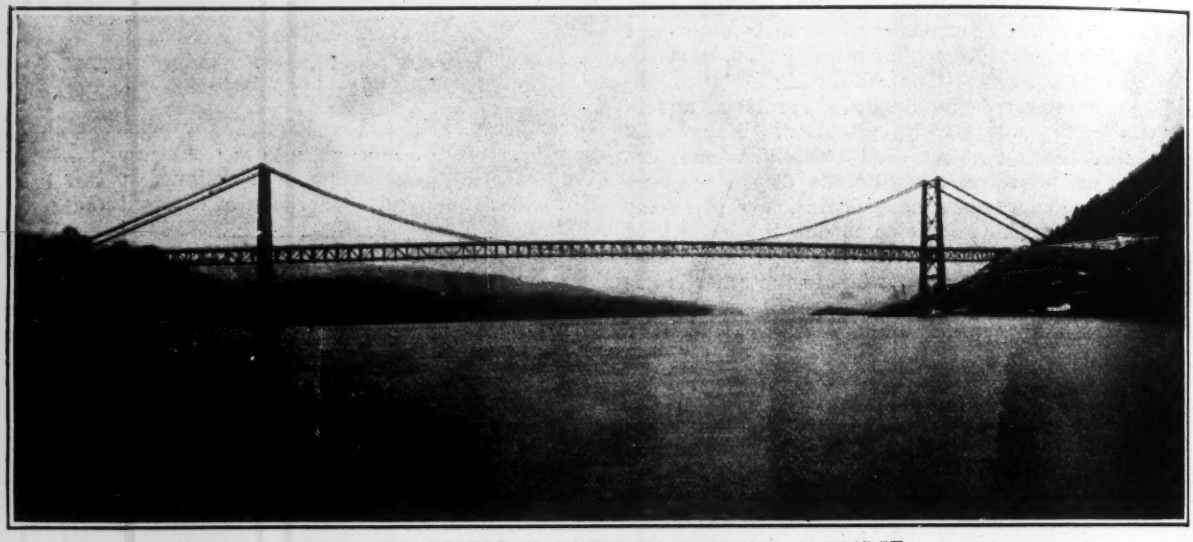
The instrument was devised by J. Schenker, of Baden, who describes it in the *Schweizerische Bauzeitung* of Oct. 25. It is being built by A. Stoppani & Co. of Berne.

Bear Mountain Suspension Bridge Over Hudson River

Design of Longest Suspension Span Yet Built—Private Enterprise Builds First Highway Crossing of Hudson in 150-Mile Stretch From Albany to Mouth of River

By Howard C. Baird
Consulting Engineer, New York City

THE Bear Mountain Bridge, crossing the Hudson River from Anthony's Nose on the east bank to Bear Mountain on the west, a few miles above Peekskill, N. Y., was completed ready for traffic Nov. 26. Wrapping of the cables, final adjustment for elevation, and covering of the anchorage pits, remains to be done, but this work will not interfere with the use of the structure. The main span, 1,632 ft. c. to c. of towers, the longest suspension bridge in the world, was completed in an extraordinarily short space of time, both the cable spinning and the erection of the suspended structure, including the concrete floor slabs. The construction of the piers and anchorages and the erection of the approaches and the towers, the latter in the winter season, while not so rapid in progress as the main span, contributed to the remarkable record of a bridge structure over the Hudson River being ready for traffic 18 months after breaking ground.

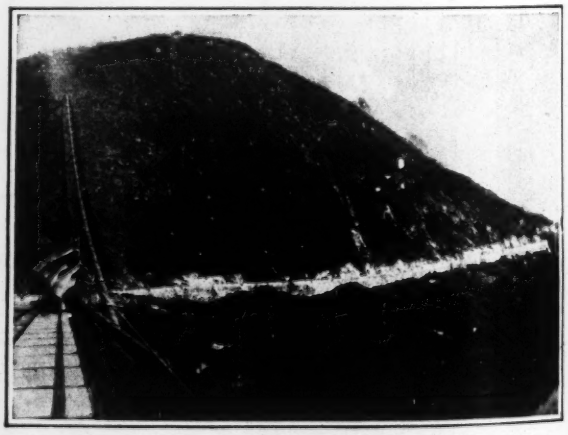


LOOKING UPSTREAM AT THE BEAR MOUNTAIN BRIDGE
Bear Mountain at left. Anthony's Nose at right. Footbridges under cables still in place on a large part of the span.

Location—The location was fixed by the available clear space at the river bank between the water and the railroad property on both sides of the river, and the topography of the high ground, into which the anchorage tunnels were driven through solid rock. The span length was fixed by triangulation and checked very closely with the joining of the two halves of the stiffening trusses at the center.

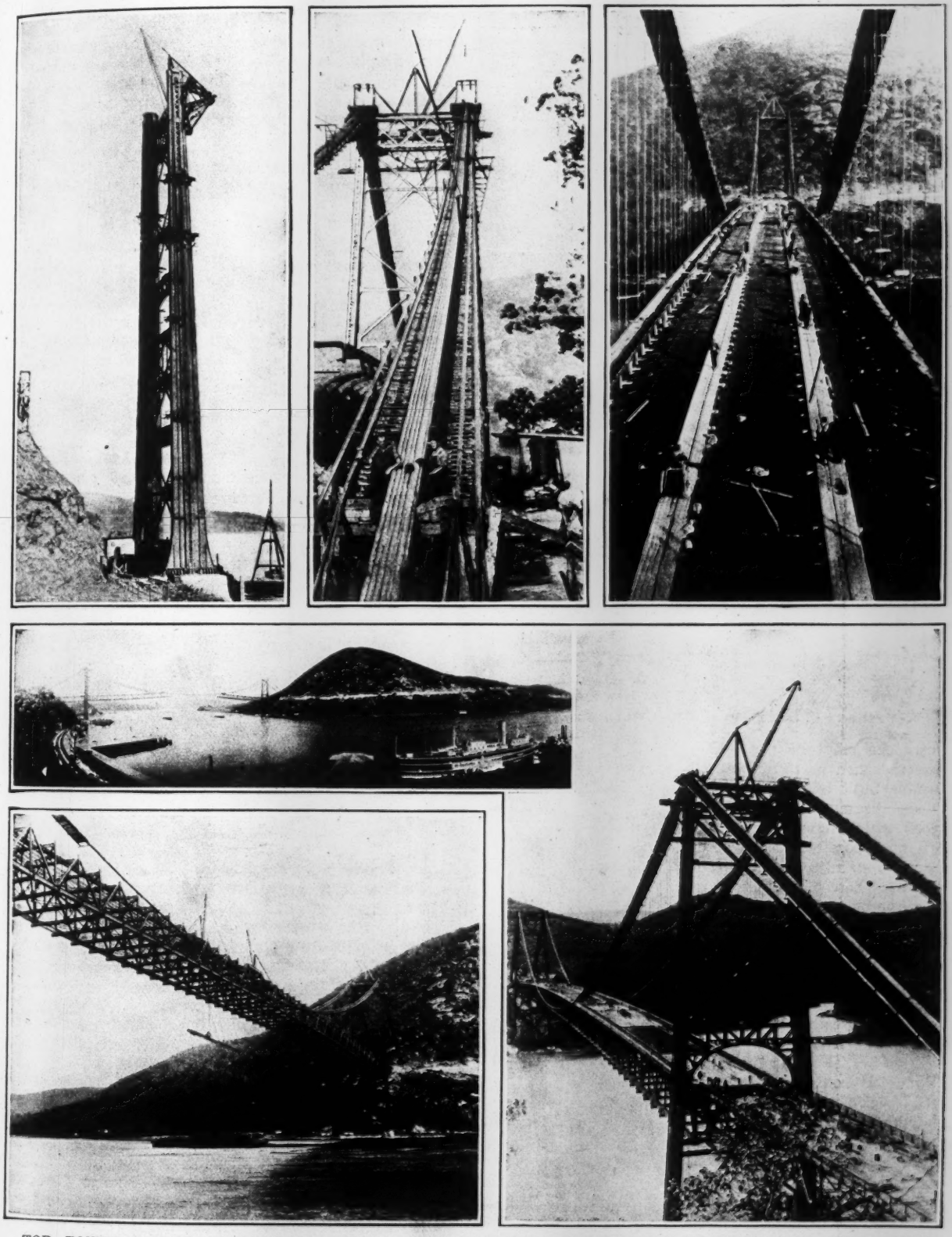
Capacity—The loading of the bridge was fixed by the charter granted the company by the State of New York, but in addition it was deemed advisable to provide a floor system capable of carrying 15-ton and 20-ton trucks so as to meet fully the requirements of modern highway traffic. The specified load of 70 lb. per square foot for the general live-load on the main-span roadway is equivalent to a total of 217 10-ton trucks, or four lines of 54 trucks each, the roadway being 38 ft. wide although a width of 20 ft. only is required by the charter. There is a 5-ft. sidewalk on each side of the roadway.

Cables and Stiffening Trusses—The suspended structure, which is of deck type, is carried by two cables with a versed sine of 200 ft. under live-load; the backstays are straight except for the sag due to their own weight. Each cable is made up of 7,252 wires of 0.192 in. diameter, drawn from openhearth steel billets and having an ultimate strength of 215,000 to 220,000 lb. per square inch after galvanizing. Cast-steel saddles carry the load from the cables to the towers and are fixed to the top of the columns, the latter being required to bend as the temperature and loading conditions change. The wire-rope suspenders are supported by cast-steel bands on the cables and at the bottom end



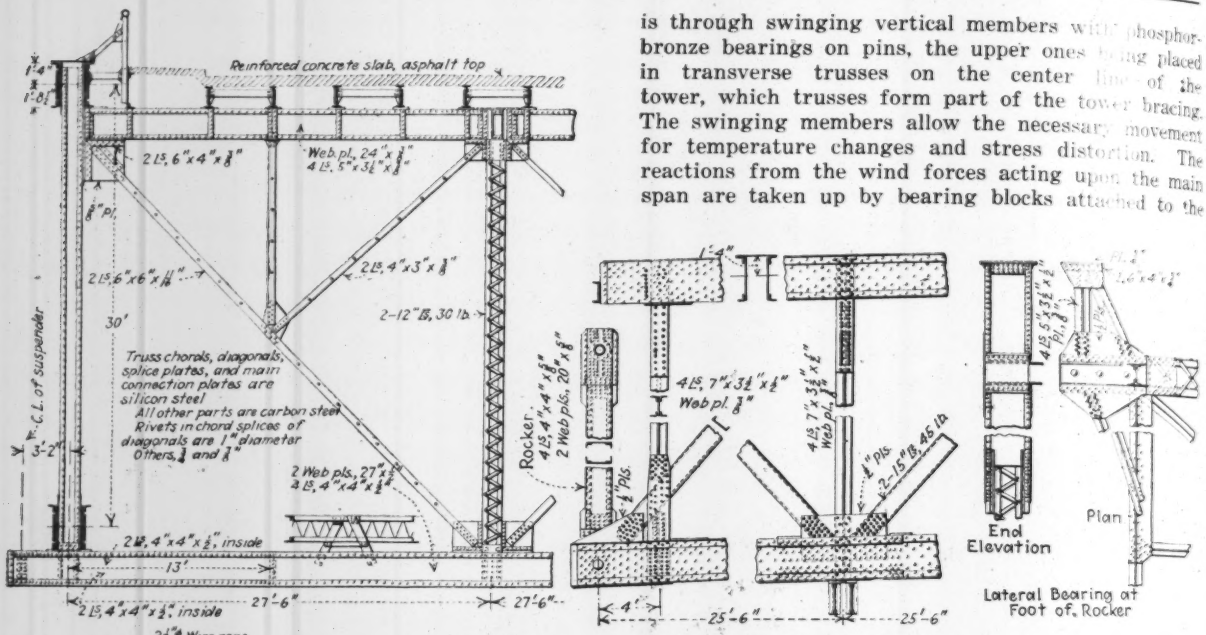
DIFFICULT EAST APPROACH ROAD CONSTRUCTED AS PART OF THE BRIDGE ENTERPRISE

Views of Bear Mountain Bridge Construction Work During 1924 Season



TOP—TOWER CONSTRUCTION, COMPLETED IN EARLY SPRING; CABLE SPINNING IN MIDSUMMER; CONCRETING THE FLOOR SLAB IN NOVEMBER. MIDDLE—STIFFENING TRUSSES APPROACHING JUNCTION. BOTTOM—WORK ON STIFFENING TRUSSES NEARLY COMPLETED; ROADWAY FINISHING (VIEW TOWARD POPOLOPEN CREEK ON WEST BANK)

is through swinging vertical members with phosphor-bronze bearings on pins, the upper ones being placed in transverse trusses on the center line of the tower, which trusses form part of the tower bracing. The swinging members allow the necessary movement for temperature changes and stress distortion. The reactions from the wind forces acting upon the main span are taken up by bearing blocks attached to the

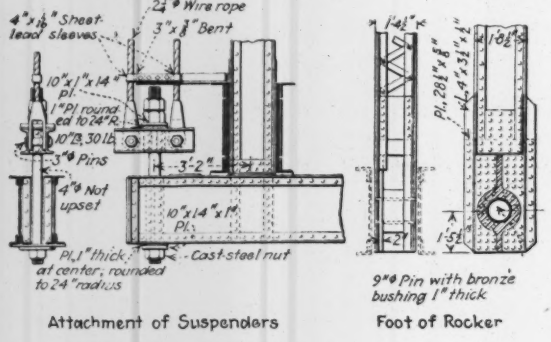

Reinforced concrete slab, asphalt top
Truss chords, diagonals, splice plates, and main connection plates are silicon steel
All other parts are carbon steel
Rivets in chord splices of diagonals are 1" diameter
Others, ¾ and ⅞"
Rocker
End Elevation
Plan
Lateral Bearing at Foot of Rocker

DETAILS OF STIFFENING TRUSSES AND SUSPENDER ATTACHMENT

sides of the tower columns in the planes of the top and bottom lateral systems.

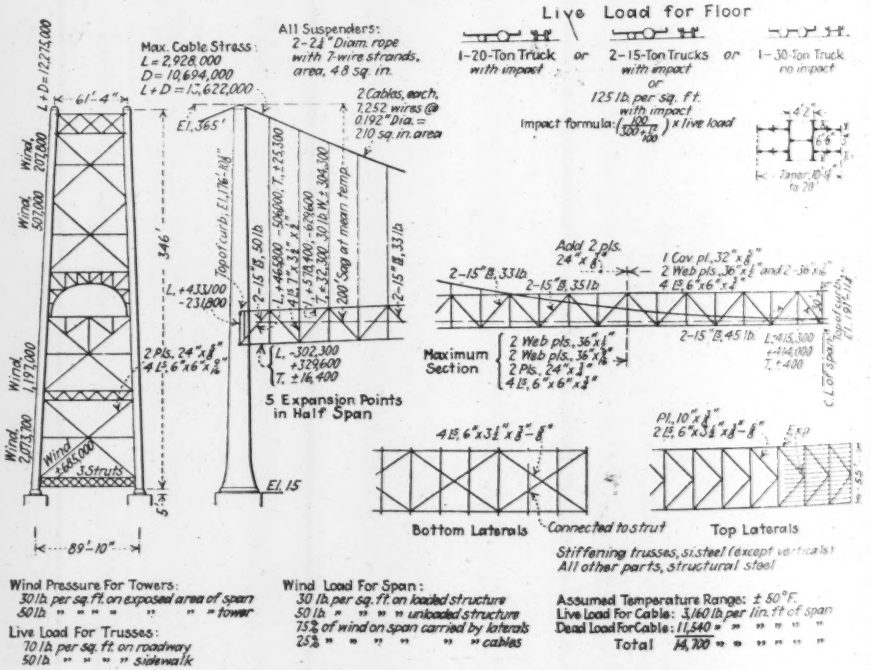
As the clearance required by the U. S. Government is 135 ft. at the shores and 153 ft. at the center, the trusses are given a camber of 15 ft., which is an advantage in general appearance and gives a grade at the tower which is tangent to the grade of the west approach.

Floor—Owing to the width between trusses, the floor stringers are supported on top of transverse trusses which form, with the bottom transverse girders re-

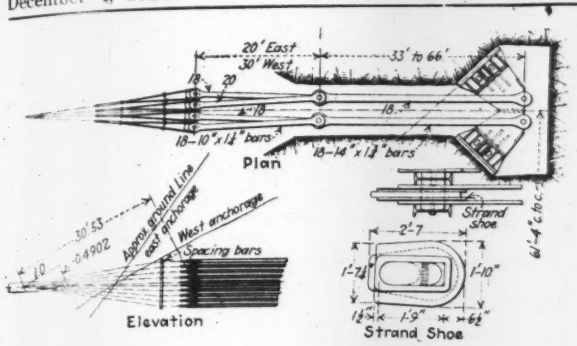


are socketed into clevises which are attached by pins to small beams built of two channels. These beams support hanger rods which have screw ends, giving a possible allowance of 5 in. for adjustment up or down. These hangers support transverse girders which carry the trusses and which were placed in position in advance of the bottom chords which rest on them.

The stiffening trusses are of silicon steel with a specified ultimate strength of 80,000 to 95,000 lb. per square inch and a silicon content of 0.20 to 0.35 per cent, and are calculated for the required live-load, which is 3,160 lb. per linear foot of span, the computations being made by the exact method for composite structures, which is based on static deformations of all the members involved. The connection of the trusses to the towers


Live Load for Floor
1-20-Ton Truck with impact
or
2-15-Ton Trucks with impact
or
1-30-Ton Truck no impact
or
125 lb. per sq. ft. with impact
Impact formula: (100/300+L) x live load
All Suspenders: 2-2½" Diam. rope with 7-wire strands, area, 4.8 sq. in.
Max. Cable Stress: L=2,928,000 D=10,694,000 L+D=13,622,000
2 Cables, each, 7252 wires @ 0.192" Dia. = 210 sq. in. area
5 Expansion Points in Half Span
Add 2 pls. 24"x⅞"
Maximum Section
Bottom Laterals
Connected to strut
Top Laterals
Stiffening trusses, si. steel (except verticals)
All other parts, structural steel
Wind Pressure For Towers:
30 lb. per sq. ft. on exposed area of span
50 lb. " " " " " " tower
Live Load For Trusses:
70 lb. per sq. ft. on roadway
50 lb. " " " " sidewalk
Wind Load For Span:
30 lb. per sq. ft. on loaded structure
50 lb. " " " " unloaded structure
75% of wind on span carried by laterals
25% " " " " " cables
Assumed Temperature Range: ± 50°F.
Live Load For Cable: 3,160 lb. per lin. ft. of span
Dead Load For Cable: 11,540 " " " " "
Total 14,700 " " " " "

PARTIAL STRESS SHEET FOR BEAR MOUNTAIN BRIDGE



CABLE ANCHORAGE IN INCLINED TUNNELS IN ROCK

ferred to above, a complete system of sway bracing. To allow for distortion of the trusses due to stress, the floor structure and the top laterals are made with ten expansion joints in the main span, the sections being 153½ ft. long except at the ends.

The roadway is paved with asphalt carried on a floor slab of concrete 6¼ in. thick, reinforced top and bottom with ⅞-in. square rods spaced 4 in. and supported by steel stringers. The reinforcing rods run the entire width of the roadway without splicing, and are bent up into the curb. The sidewalks are of concrete, 5 in. thick, reinforced, and are carried on the concrete curb at their inner edge, the outer edge being supported on steel fascia stringers.

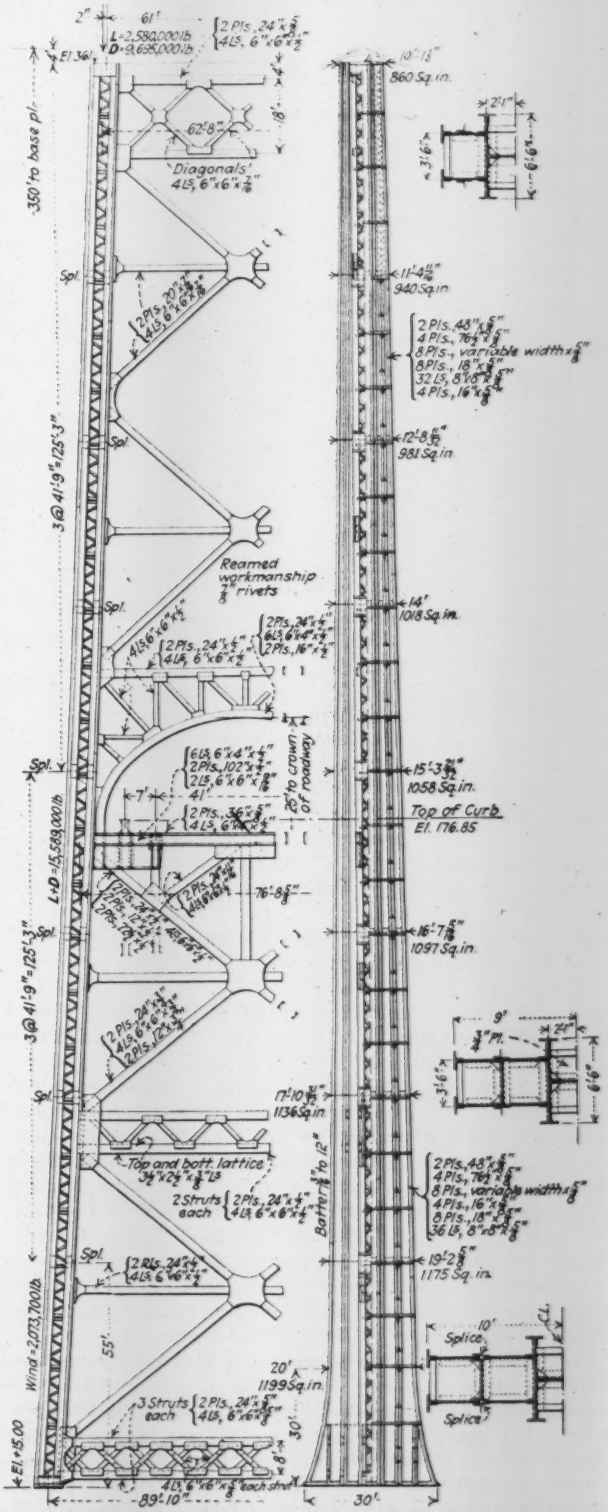
Towers—The towers are 350 ft. high and have a base width of 89 ft. 10 in. and a width of 61 ft. 4 in. at the saddles. The batter allows the connections of the main-span and approach-span trusses to be made between the columns, and on the center line of the tower. The material of the towers is structural steel, A. R. E. A. specifications, except for the saddles and bases, which are of cast steel. The tower piers are of concrete built on solid rock.

As the towers were erected complete before the approach spans were placed and before the footbridge cables were strung, the overturning effect of a broadside wind had to be provided for in the anchors and the splices, in addition to the effect of the eccentric load of the creepers, which overhung the river side of each tower.

Wind Pressure—In computing wind pressure on the finished bridge, a force of 50 lb. per square foot was taken on the exposed surfaces of the towers to provide for a local concentration of pressure, and in addition 30 lb. per square foot on the exposed surfaces of the cables and main span and approaches, including an allowance for exposed surfaces of the live-load.

Anchorages—The anchorages are made up of 74 eyebars for each cable, or two for each of the 37 strands into which the cable divides at the ends, the wires being carried around cast-steel shoes with adjustable pin bearings; these bars are pin-connected to other bars of various lengths to suit the length of the tunnels, and the last set of bars is pin-connected to steel castings which act as shoes to distribute the pressure on the rock. The anchor bars do not change direction, but are in line with the backstays and are laid flat, this being necessary to suit the arrangement of the shoe castings. The pits are filled with concrete up to a few feet back of the cable connections.

The approach spans are unusual only in the spacing of the trusses to suit the wide roadway. Except in the case of the plate girders, transverse trusses are used instead of floorbeams, these trusses forming sway bracing as on the main span. The live-loads for the girders and the trusses, varying from 50 ft. to 210 ft.,



CABLE-SUPPORT TOWERS—BATTERED POSTS CLEAR THE STIFFENING TRUSSES AND PERMIT CENTRAL ROCKER ARRANGEMENT

were increased over those required for the main span in order to meet usual requirements for such lengths of highway spans.

The bridge was constructed for the Bear Mountain Hudson River Bridge Co., Wilson Fitch Smith, chief engineer. The contractor was the Terry & Tench Co., afterwards the Tench Construction Co., J. V. W. Reynders, representative. The writer was retained by the bridge company as consulting engineer to design the structure and to supervise the construction. Francis P. Witmer was associated with the writer on the preparation of the design, and H. D. Leopold was resident engineer.

Illinois Central R.R. Begins Work on Illinois-Kentucky Main Line

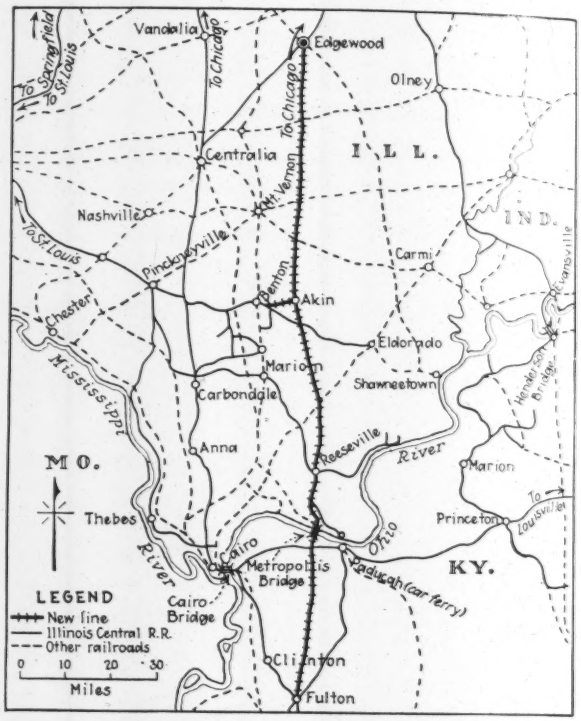
IMPROVED facilities for through traffic of the Illinois Central R.R. between Chicago, Memphis and New Orleans will be provided by the 166-mile direct line from Edgewood, Ill., to Fulton, Ky., contracts for which were let in November. This new line, utilizing the Metropolis bridge over the Ohio River, will supplement the existing line between Edgewood and Fulton, which latter passes through Carbondale and over the Cairo bridge. Both lines are not only parts of the main route to the South but are in a coal district in Illinois which produces heavy traffic. In addition there is heavy coal traffic north from the Louisville division, which joins the main line at Fulton.

Both physical and traffic conditions provide reasons for this improvement. The present line between the points named has maximum grades of 1.25 per cent and considerable curvature in approaching the Ohio River from the north, while the new line will give few and light curves, maximum grades of 0.3 per cent and a saving in distance of twenty miles. Furthermore, the Cairo bridge is a single-track structure forming a bottleneck in a double-track line carrying heavy traffic, while the Metropolis bridge is a modern double-track structure.

Placing a new double-track structure on the piers of the Cairo bridge was proposed some time ago, as noted in *Engineering News-Record* of Dec. 21, 1921, p. 912, thus following a method of relief already carried out at some other Ohio River bridges. This would have been an expensive work, however, and would need to be supplemented by extensive grade reduction on the present main line in order to meet traffic requirements. Ultimate economy was found to lie in the construction of the new main line with utilization of the more modern Metropolis bridge, for which reason the Illinois Central R.R. has now purchased a one-third interest in the bridge. This bridge, opened in 1917, was built jointly by the Chicago, Burlington & Quincy R.R. and the Nashville, Chattanooga & St. Louis R.R. to complete a new north and south traffic route. It has a 720-ft. channel span built of silicon steel.

This new main line, which is to be built under the name of the Southern Illinois & Kentucky R.R., is estimated to cost about $17,000,000 or $100,000 per mile. The project has been passed upon by the Interstate Commerce Commission and upon the record of all the facts it was held by the Commission that public necessity and convenience required the construction of the line and that it was in the public interest that it should be built. A ten-mile branch to tap a coal district in southern Illinois will be built from Akin, Ill., on the new line, to Benton on one of the local coal lines of the Illinois Central R.R. Construction on this branch has been under way for the past year.

Surveys and plans were made under the direction of F. L. Thompson, chief engineer of the Illinois Central R.R., and the work will be in charge of E. L. Crugar, engineer of construction. Work on one of the contract



NEW LINE FOR ILLINOIS CENTRAL RR.

sections was commenced in November and it is expected to have active work in progress along the line during the winter, while it is planned to have the railroad completed during the year 1926. For construction the work is divided into eight sections which have been let to separate contractors, as follows: (1) Shugart & Blythe Brothers, Nevada, Iowa; (2) John Marsch, Inc., Chicago; (3) Blythe Brothers, Farina, Ill.; (4) States Corporation, Chicago; (5) A. Guthrie & Co., Chicago; (6) Flick Construction Co., Chicago; (7) Dominion Construction Co., Niles, Mich.; (8) H. W. Nelson Co., Fulton, Ky.

Year's Income from Forests Is $5,000,000

Receipts from national forest resources during the fiscal year ending June 30, 1924, totaled $5,251,903, according to the final tabulation made by the Forest Service. This amount is $84,000 less than the receipts for the previous fiscal year but is $840,000 larger than the average annual receipts of the preceding five years. Sales of timber and livestock grazing permits were responsible for most of the money received, $3,036,395 having been paid for timber and $1,915,561 for grazing permits. Permits for the use of national forest lands for summer homes and other forms of special use, including water power, brought in $299,946.

Studies of Separate Sludge Digestion at Baltimore

Three Years' Investigation at Sewage-Works Shows Most Rapid Digestion in First Few Weeks—One-Third Seeding Sludge and Liquefaction by Aerobes Desirable Features

By T. C. Schaetzle
Senior Assistant Sanitary Engineer, Maryland State Department of Health, Baltimore

Production of approximately 6½ cu.yd. of undigested, 90 per cent moisture sludge per million gallons of sewage in 1920 in the city of Baltimore gave the writer, then principal sanitary chemist at the sewage-works, striking evidence of the overwhelming emphasis which should be placed on the question of sludge treatment. He undertook, therefore, a series of sludge digestion experiments in the late spring of 1920, which were conducted under the general supervision of Milton J. Ruark, division engineer of sewers, and extended over a period of almost three years. Although the findings are not complete or conclusive in many details, the writer feels that a general summary of the work there accomplished may clarify some phases of the separate sludge digestion process.

At the Baltimore sewage-works the sewage passes through bar screens, is clarified in primary plain settling tanks, is re-screened through fine-mesh revolving screens, passes through the trickling filters, is re-settled in two large basins and is then discharged into Back River. Under normal operating conditions the primary settling tanks are cleaned after ten days' to three weeks' operation in summer and three to six weeks' operation in winter. The sludge removed is deposited into the digestion tanks, of which there are at present about 52, ranging in depth from 13 to 27 ft. Under normal conditions it remains here until digested and is then placed on the sludge drying beds. It has usually been assumed that the digestion period ranges between three and six months, although no definite data were available to substantiate this assumption.

Because of the enormous quantities of sludge to be treated it was advisable to conduct these experiments in such a manner as to give primary consideration to the economic and practical operation features of the separate digestion process and to obtain such laboratory data as would be most advantageous to the practical improvement of plant operation. The experiments were divided, therefore, into a consideration of the following principal items: (1) What is the minimum period of sludge digestion required under the climatic conditions prevailing in Baltimore; (2) what proportion of digested sludge is needed for seeding purposes; (3) what is the most economical depth of tank for separate sludge digestion, and (4) what means may be used to hasten the digestion of raw sludge. Past experience of the writer has shown that a well digested Baltimore sludge contains from 42 to 53 per cent of volatile matter. Such a sludge is coal black, streaks well, has a slight tarry odor and dries readily when placed on the sludge beds. In these experiments it was decided, therefore, to consider all sludges with a volatile content of 53 per cent or less as completely digested and all others as either partly digested or raw.

Experiments—In the experiments two sets of tanks were operated, the one, a set of three shallow tanks 3 ft. deep; the other, a set of four tanks, 10 ft. deep. The latter were equipped with three draw-off points, one at the bottom, one 6.7 ft. and one 3.4 ft. from the top. By this arrangement the condition of the sludge at the various depths could be readily observed. The shallow tanks were operated in two stages. During the first period the experiment was as follows: One tank was filled with undigested sludge, a second one was filled with undigested sludge and its alkalinity altered by the addition of calcium oxide, and a third one was filled with one-third well digested and two-thirds raw sludge. All tanks were allowed to remain dormant, except for a stirring with a paddle at each weekly sampling period, in order to learn the time required for complete digestion.

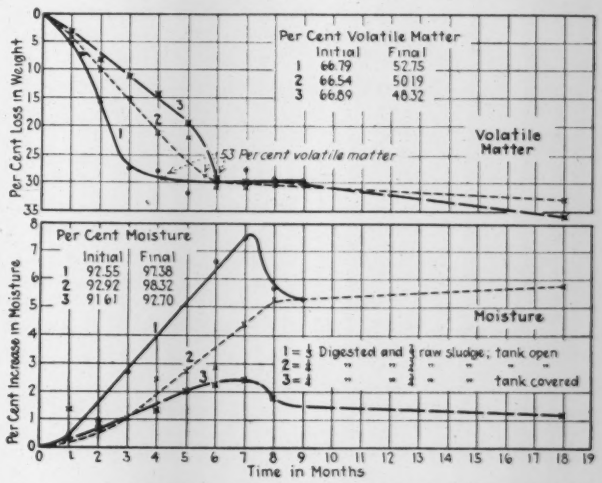

Per Cent Volatile Matter
Initial Final
1 66.79 52.75
2 66.54 50.19
3 66.89 48.32
53 Per cent volatile matter
Volatile Matter
Per Cent Loss in Weight
Per Cent Moisture
Initial Final
1 92.55 97.38
2 92.92 98.32
3 91.61 92.70
Moisture
1 = ½ Digested and ½ raw sludge, tank open
2 = ¾ " " ¼ " " "
3 = ¾ " " ¼ " " tank covered
Per Cent Increase in Moisture
Time in Months

FIG. 1—PROGRESSIVE SLUDGE DIGESTION IN SHALLOW TANK AT BALTIMORE SEWAGE-WORKS

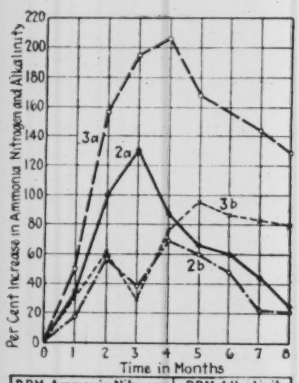
A summary of the data obtained in this experiment shows that raw sludge, whether treated with lime or not, is not fully digested after six months. The lime treatment apparently does not bring about complete digestion as readily as seeding sludge does, but it hastens the digestion of unseeded raw sludge.

These data show, also, that there was a gradual digestion in all tanks during the early weeks of the experiment and that, after 14 weeks, the seeded tank had practically reached a state of equilibrium when the volatile matter content of the sludge was approximately 52½ per cent. After this period little additional digestion took place (see Curve 1, Fig. 1). With the untreated raw and the lime-treated raw sludges an equilibrium was reached after 16 weeks, at which time the volatile matter content of the sludges was 66.3 and 57.2 per cent respectively. After this period the rate of digestion became very slow, probably due in part to the colder weather after the middle of October.

For the first twelve days of these experiments a heavy scum appeared on all tanks within 48 hours from the time of thorough stirring. After this the lime treated tank was always free of scum, whereas it persisted on the seeded tank for a period of 96 days and on the untreated raw sludge tank for 181 days. The typical odor of raw sludge emanated from the untreated tank

throughout the six-month period and although the lime treated sludge had digested more than the untreated raw sludge, the odor from it was always disagreeable—more so than from the untreated raw sludge.

Although all the data accumulated by the writer show no definite and consistent relation between the alkalinity and ammonia nitrogen content of a sludge and its degree of digestion, a compilation of a long series of determinations on various types of tanks and kinds of treatment indicate that, when the alkalinity and ammonia nitrogen content of a sludge are greater or less than approximately 3,400 and 600 p.p.m. respectively it approaches an undigested condition. These data indicate, also, that the rate of approach to the undigested state is the more rapid when these constituents are less than the above stated values.



	P.P.M. Ammonia Nitrogen			P.P.M. Alkalinity	
	Initial	Final		Initial	Final
2a	340	420	2b	1,720	2,080
3a	360	820	3b	2,100	3,760

FIG. 2—INCREASE IN AMMONIA AND NITROGEN AND ALKALINITY IN SHALLOW TANK

Tanks were filled with ¼ of digested and ¾ of raw sludge. Tank 2 was open and tank 3 covered.

In the second stage of these experiments the operation of the shallow tanks was continued with variations. The tank originally filled with raw sludge and allowed to be dormant, except for stirring at times of sampling, was continued under the same conditions. This was to learn the ultimate time for complete digestion of an untreated and unseeded raw sludge. Tanks 2 and 3 were refilled with one-fourth fully digested and three-fourths undigested sludge, by volume. Tank 3 was covered to reduce the effects of evaporation and to prevent the addition of rainwater.

While the second phase of the shallow tank operation began about the end of April, 1921, the four large experimental tanks were placed in operation approximately two weeks later. These tanks were filled and operated as follows: (I) Filled with well digested sludge. About every four weeks thereafter 20 per cent of the tank volume was drawn off from the various depths and replaced by raw sludge at the surface. (II) Filled with a one-third and a two-third mixture of digested and undigested sludge, by volume. Then allowed to be dormant with no stirring at sampling periods as in the case of the shallow tanks. (III) Filled the same as Tank II. Through a system of perforated pipes, placed on the bottom of the tank, air was forced once each day so as to mix the digested and undigested sludges thoroughly and to prevent a heavy scum formation. This mixing with air, at an initial pressure of 130 lb., took from three to five minutes so that the "activated-sludge" principle was not an important factor in the experiment. (IV) Filled with raw sludge and allowed to be dormant for comparison with the untreated and unseeded raw sludge in the shallow tank. Stirring, even at sampling periods, was eliminated to learn what effect, if any, this agitation has on the process of digestion.

The chemical analyses made consisted of determinations for moisture, volatile matter, alkalinity as $CaCO_3$, and ammonia nitrogen. The bacteria investigation included a study of the aerobic bacteria present in the various sludges. A study of the anaerobic types was attempted, but was unsuccessful largely because of the inability to obtain good anaerobic plates in the time available for this portion of the experiment.

With reference to the second phase of the shallow tanks operation a picture is furnished by Figs. 1 to 3. From Curve 1a, Fig. 3 (which is for the shallow tank, started in the middle of June with a raw, acid sludge), it is evident that a completely digested sludge can not be obtained from raw sludge alone in less than 14 months. Beyond a 15-month digestion period the reduction of organic matter and consequent loss of weight is slow. In fact, a total digestion period of 28 months produces a sludge containing 45.61 per cent volatile matter which is equivalent to a total loss in weight, in 2¼ years, of 51.2 per cent; or 45 per cent for the first 15 months as against 6.2 per cent for the last 13 months. The increase in moisture is not proportional to the loss in organic matter, because of the access of rainwater into the tank and the effect of evaporation, but a general

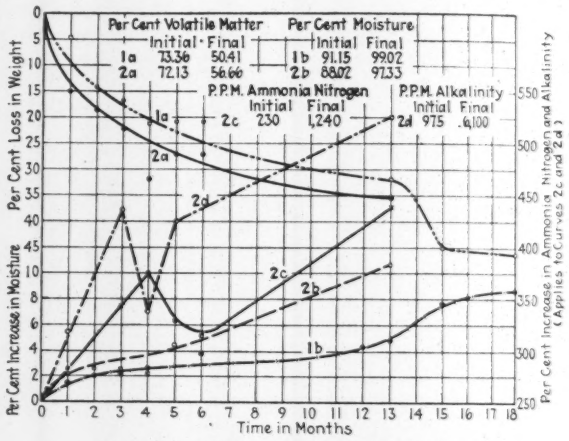


FIG. 3—DIGESTION OF UNTREATED AND UNSEEDED SLUDGE

Average of all depths: 1 = shallow and 2 = deep tank.

relationship between digestion and liquefaction is shown by the percentage increase in moisture and percentage loss of weight curves in Fig. 3.

Measurements of the rate of digestion by loss in weight of the sludge on a dry basis, figured from the change in its volatile matter content, as shown in the volatile matter curves 1, 2 and 3, Fig. 1, indicate clearly that a completely digested sludge can be obtained in six months with either one-third or one-quarter of the tank volume of seeding sludge regardless of whether the tank is covered or open. It is apparent, however, that a one-third seeding volume will produce a digested sludge of 53 per cent volatile matter in slightly more than four months. Although this period is shorter than approximately 5½ and 6 months respectively for the open and covered tanks, seeded with digested sludge to the extent of one-fourth their volumes, it may be partly due to variations in seasons, as the one-third volume tank was started in June of one year and the others in the latter part of April of the next year.

Moisture curves 2 and 3, Fig. 1, indicate clearly the relative effect of precipitation and evaporation. For the first six months, while digestion was progressing rapidly in the covered tank, the moisture content of this tank increased (curve 3). Following this a period of slow

digestion ensued during which time evaporation was greater than liquefication with a consequent reduction of moisture content.

Observations made throughout these experiments indicate that the less the volume of seeding sludge the longer a scum will exist on the tanks and that a covered tank will retain its scum longer than an uncovered one. Both flies and gnats, "psychoda alternata," were very numerous on the covered tank during the hot weather, whereas they were present on the uncovered one in small quantities for a very short period only.

Fig. 3 furnishes the additional information that raw sludge digests more rapidly in a tank 10 ft. deep than in one 3 ft. deep. At the same time, it shows that, even in comparatively deep tanks, raw sludge will not digest fully in less than 13 months.

TABLE I—RAW SLUDGE DIGESTION AT VARIOUS DEPTHS

Sample Period	Per Cent Volatile Matter at Surface (1)	3.4-Ft. Depth (2)	6.7-Ft. Depth (3)	10-Ft. Depth (4)
At start (June)	72.39	71.86	Water	Water
After 1 month	67.55	Water	Water	66.57
After 2 months	69.63	Water	Water	61.84
After 3 months	68.22	66.12	65.37	56.58
After 4 months	68.06	63.04	50.89	53.91
After 5 months	65.88	Water	Water	57.49
After 6 months	68.22	Water	Water	56.93
After 13 months	Water	Water	56.91	56.41

Other interesting facts shown by the experiments are supplied by Table I. Here it is shown that, with the exception of the fourth-month figure for the 6.7-ft. depth, raw sludge digests more completely with increasing depths, at least up to 10 ft. The interchange of the water strata with the change from an undigested to digested state would tend to indicate that the digested sludge loses its buoyancy through the escape of gas during the digestion process.

For the practical operation of the separate sludge-digestion process, the shallow tank experiments clearly indicated the advisability of seeding. A comparison was made, therefore, of deep and shallow tanks seeded and of agitated and dormant seeded tanks. The results of these comparisons are given in Fig. 4. For the deep versus the shallow tank it appears that digestion was more rapid in the former during the first 2½ months. After three months, digestion in both types of tanks is materially slowed down and, after four months, it is practically stationary in the deep tank. A similar condition is reached in the 3-ft. tank after six months.

A study of the volatile matter curves 2 and 3, Fig. 4, would seem to indicate that air agitation does not improve either the rate or degree of digestion in a given period of time. Although not a help in digestion, air agitation is a help in practical operation. It prevents the formation of a heavy, dry scum, thereby making it possible to obtain more uniform sludge at each period of withdrawal. On the other hand, the action in the dormant tank was similar to that in the 3-ft. tank with respect to scum formation. In both types of tanks the scum disappeared in three months. In fact, after four months, all sludge was at the bottom of the deep dormant tank. Throughout these experiments the better digested sludge was at the bottom with a gradation in quality up to the surface. This fact tends to show more rapid digestion near the surface, but not necessarily more complete, because of the higher organic content of the surface sludge as compared with that from the 10-ft. depth.

Fill-and-Draw Operation—From an economical consideration of sludge capacities it is better to draw sludge frequently. In an endeavor to obtain some information as to the least period of time required for digestion, with a definite replacement at regular intervals shorter than three months, one tank was operated on a monthly fill-and-draw basis.

Some of the interesting information furnished by this experiment is shown by Fig. 5. For the first 22 days the digested sludge was allowed to be dormant, after which an average of all depths showed a decrease in volatile matter from 48.2 to 44.08 per cent. Immediately upon the addition of 20 per cent of raw sludge this value rose to 48.45 per cent and the uniformity of distribution was disturbed, the surface sample increasing in volatile matter from 47.65 to 58.97 per cent. The next four weeks showed a loss of weight of only 2.79 per cent as against 7.5 per cent for the first period, thereby registering the effect of the addition of raw sludge. From the beginning of the experiment until the addition of raw sludge on Dec. 29, at which time 100 per cent of the original volume had been withdrawn and replaced, a 53 per cent volatile matter sludge was obtainable with a 20 per cent replacement each four weeks. The cold weather seemed to interfere with the process after this, as shown by a loss in weight of only 16.2 per cent in

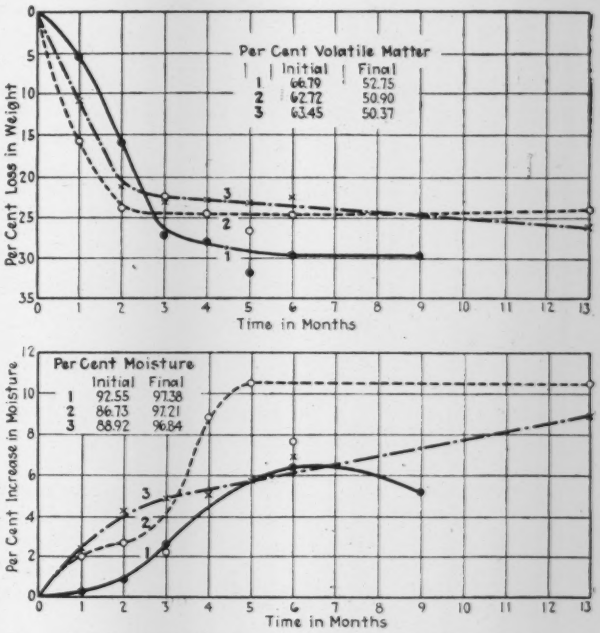


FIG. 4—SLUDGE DIGESTION IN SEEDED TANKS
1 = small dormant tank; 2 = large dormant tank; 3 = large agitated tank.

TABLE II—CLASSIFICATION OF BACTERIA

Name of Organism	Number Found in Digested Sludge	Raw Sludge
Bacillus cereus (group)	32	8
Bacillus mesentericus	4	2
Bacillus vulgatus	1	0
Bacillus fusiformis	2	4
Bacillus petasites	0	1
Bacillus subtilis	0	1
Bacillus laterosporus	1	0
Alcaligenes fecalis	1	3
Bacillus a (not identified)	0	9
Bacillus a (not identified)	0	2
Organism c (not identified)	5	1
Total	46	31

TABLE III—PER CENT VOLATILE MATTER—BACILLUS CEREUS RELATION

Date 1921	Kind of Sludge	Per Cent Volatile Matter	No. of B. Cereus Isolated
June 20	Digested	48.20	20
July 7	Raw	72.13	3
July 7	Digested	44.08	2
July 27	Raw	67.06	5
July 27	Digested	46.44	10

the last 166 days of the experiment as against as much as 20.2 per cent in the period from Nov. 21 to Dec. 28.

A comparison of tank II, dormant (curve 2, Fig. 4), which was seeded with one-third of its volume of digested sludge and then filled with a 72.13 per cent volatile matter raw sludge, with the tank used for the fill-and-draw operation (Fig. 5) indicates that the nature of the raw sludge added has considerable effect upon retarding or hastening digestion. This might be expected because of the changes in the types of organisms and food supply. As an illustration of this, during the first four weeks after the addition of raw sludge to the 80 per cent seeded tank, the loss in weight was only 2.79 per cent as against 15.75 per cent for the 33.33 per cent seeded tanks. When similar raw sludges are added, however, this decrease is more nearly equal. Thus, for the one-third seeded tank, using 72.13 per cent volatile matter raw sludge, the loss was 15.75 per cent in 30 days as compared to the 80 per cent seeded tank loss of 20.18 per cent in 37 days, when the raw sludge used contained 73.04 per cent volatile matter.

From the results shown by Fig. 5, it is evident that a loss in weight of 20.18 per cent is the maximum to be expected in five weeks on the fill-and-draw basis. If this is uniform, the loss will be about 16.1 per cent in four weeks. On this basis, therefore, it is evident that sufficient digested sludge must be kept in a tank so that the organic matter is not greater than 60.5 per cent, if monthly replacements of 20 per cent are to be used. Otherwise a lesser volume of replacement or a longer digestion period must be resorted to.

Bacterial Data—In this phase of the work, the major portion of which was done by Dr. J. W. Swenarton, now a bacteriologist in the Baltimore Health Department, an attempt was made to determine, if possible, what microorganisms are responsible for the digestion of sludge. For this purpose, samples of raw and fully digested sludge were used.

In making the bacterial examinations, dilutions up to 1 to 1,000,000 were plated on plain agar and incubated for 24 hours at 37 deg. C. All visible colonies on a representative portion of the plates of highest dilution which showed well isolated colonies were secured in pure culture. In all, 77 such cultures were obtained and studied morphologically and culturally. From this study

TABLE IV—LIQUEFYING VERSUS NON-LIQUEFYING BACTERIA IN AGITATED AND DORMANT TANKS

Date 1921	Number of Pure Cultures Isolated		Number of Liquefiers — Rapid		Number of Liquefiers — Slow		Number of Non-liquefiers	
	Dormant	Agitated	Dormant	Agitated	Dormant	Agitated	Dormant	Agitated
July 7	9	10	4	1	2	2	3	7
Dec. 12	14	13	2	6	8	5	4	2

the cultures were grouped and identified as far as possible.

The general classification of isolated organisms is given in Table II. It will be noted that, of the 77 cultures obtained, 52 per cent belonged to the Bacillus cereus group and that this form predominates in well digested sludge. In fact, a summary of B. cereus against all other organisms shows an average of 69.5 per cent of B. cereus and 30.5 per cent of others in the digested sludge, as against 25.8 and 74.2 per cent, respectively, for these forms in the raw sludge. The several other organisms besides B. cereus, which are found in greater numbers in the digested sludge than in the raw sludge, with the exception of organism *c*, are rapid liquefiers. This is an important observation, since the organisms which are found in greater numbers in the raw sludge are relatively slow liquefiers. These data would indicate that a large part of the liquefaction taking place in the digestion of sludge is due to the rapidly

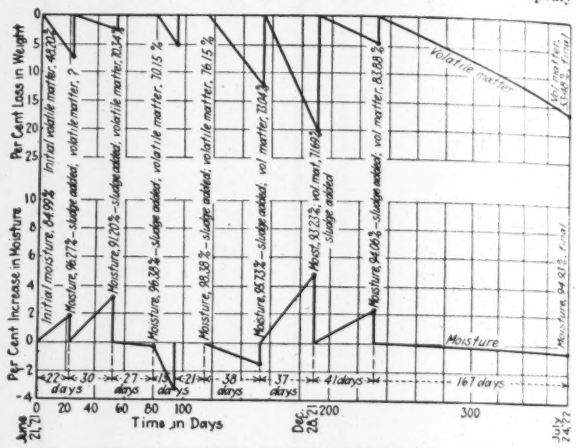


FIG. 5—SEEDED-SLUDGE DIGESTION IN DEEP FILL-AND-DRAW TANK

Moisture and volatile matter average of all depths.

liquefying spore-bearing aerobes. During this investigation not a single gas forming aerobe was isolated. While it is not doubted that this variety might be found by making isolations from low dilutions it is believed that they are comparatively few in number. Since B. cereus is, apparently, the most active liquefier, a comparison of the numbers of them isolated in sludges of various degrees of digestion is interesting. If the degree of sludge digestion is based upon the volatile matter results, Table III affords an index of the relation between sludge digestion and densities of B. cereus.

An additional bacteriological experiment made upon the dormant and agitated, seeded, deep tanks produced the results shown in Table IV. A five-month period of digestion increases the liquefiers in the dormant tank from 67.67 to 71.5 per cent and in the agitated tank from 30 to 84.7 per cent. These data tend to show that air agitation helps digestion.

In the anaerobic isolation work undertaken, the method used was that adopted by the Committee upon Anaerobic Bacteria and Infection of the British National Research Council, which is described in their Report No. 12, on the classification and study of anaerobic bacteria of war wounds. As previously stated, it was impossible to get good anaerobic plates and this phase of the investigation had to be discontinued.

Since no gas-forming aerobes were isolated from the sludge, it was thought possible that the gas escaping from fermenting sludge was due to anaerobes. To determine whether this was true or not, the following experiment was carried out. A count of anaerobic gas formers was made on samples of raw and actively fer-

menting sludges by placing 1 c.c. of dilutions up to 1 to 10 million into litmus milk and putting the tubes under anaerobic conditions by the Wright method. (*Journal* Boston Soc. Med. Sc., 1900, iv. 114.) Total aerobic counts on gelatin at 20 deg. C. and on plain agar at 37 deg. C. were made and figured on the dry basis. The results of this test are shown in Table V. The total

TABLE V—BACTERIAL COUNTS PER GRAM OF DRY MATTER

	Fermenting Sludge	Raw Sludge
Gelatin 48 hr. at 20 deg. C.	1,400,000	544,000
Plain agar 48 hr. at 37 Deg. C.	8,200,000	2,109,000
Anaerobic milk 96 hr. at 37 deg. C.	4,000,000	4,219,000

counts on both gelatin and agar were higher for digesting sludge than for raw sludge. Anaerobic gas formers seem to be as numerous in the raw material as in the fermenting material. No conclusions should be drawn from a single test, but it would seem probable that the gassing of sludge is due largely to anaerobes of the type which produce gas and clotting in milk. This reaction is very similar to that by B. welchii. The milk is firmly clotted and gas is produced in large quantities.

Summary—In these, as in other sewage experiments, many conflicting data have been obtained. The following general conclusions, however, seem warranted:

1. Digestion takes place most rapidly in the first few weeks, after which it slows down until reaching a point of apparent equilibrium when it continues very slowly, if at all.

2. If raw sludge is seeded, the time required to obtain a sludge containing 53 per cent or less of volatile matter is dependent upon the organic content of the initial mixture of the raw and digested material.

3. Under similar conditions, digestion is more rapid if a tank is seeded with one-third of its volume than if only one-fourth of its volume is seeded.

4. During the warm seasons at least three months should be allowed for the digestion of seeded sludge, if the entire two-thirds volume is to be replaced by raw sludge at each filling.

5. Cold weather retards digestion and tanks should be seeded therefore in warm weather.

6. If a fill-and-draw method is used, the shortest practical period of digestion is one month and then less than 20 per cent replacement should be used.

7. Raw sludge left to itself requires at least 14 months for complete digestion.

8. Sludge, either raw or seeded, digests more rapidly, but not necessarily more completely, in deep than in shallow tanks.

9. Agitation of seeded sludge by air does not improve the rate or the degree of digestion, but does prevent scum formation and thus facilitates the practical operation of sludge-digestion tanks. It is the writer's belief that frequent intimate contact between digested and undigested sludge helps digestion. Although air agitation failed to prove this conclusively, it may have been due to the change in the types of organisms in the sludge brought about by the addition of oxygen. Such a difficulty would be overcome by mixing with a mechanical agitator or by pumping.

10. Raw sludge may be acid or somewhat alkaline, but well digested sludge contains approximately 3,400 p.p.m. of alkalinity as $CaCO_3$.

11. An immediate mixture of the seeding material with the raw sludge being placed in a digestion tank aids digestion.

12. Under similar conditions digestion is less rapid in a covered tank than in an uncovered one and flies and gnats are more prevalent around a covered digestion tank.

13. If the sludge is neither withdrawn from nor added to a digestion tank, scum will persist about twice as long on undigested as on digested sludge and it will remain on digested sludge, whether broken up weekly or not, for about three months.

14. Even if a digested sludge of a definite nature could be obtained for seeding at all times, the organic content of the raw sludge constantly changes to such a degree as to make it impossible to predict the exact action that will follow when the two kinds of sludges are mixed.

15. The bacteria which cause gassing and liquefaction of sludge are of two distinct types and the best liquefiers are not gas formers.

16. Liquefaction is accomplished, to a large extent at least, by aerobes of which B. cereus is apparently the predominating type and most rapid in action.

17. Gassing is probably largely due to anaerobes of the type which produce gas and clotting in milk.

The author wishes to acknowledge his indebtedness to Abel Wolman, chief engineer of the Maryland State Department of Health, for his valuable suggestions in the preparation of the subject matter and form of this article; to J. R. McComas, assistant sanitary engineer of the Maryland State Department of Health, for his assistance in the preparation of the charts; to C. E. Keefer, assistant designing engineer of the Baltimore City Sewer Division, for the design of the large experimental tanks; to J. W. Holden, superintendent of the Baltimore sewage-works, for his co-operation in the field work involved in the experiments, and to Herman Kratz, Jr., and Frank Applestein, assistant chemists at the Baltimore sewage-works, for their assistance in making the analyses. Finally, the author wishes to emphasize the fact that the work here outlined is only a beginning and that a large field for laboratory investigation is offered by the question of sludge digestion.

Bascule Bridge for China

A rolling-lift span of the Scherzer type, 152 ft. c. to c. of piers and giving a clear channel of 140 ft., will be the principal feature of a new highway bridge over the Hai Ho River at Tientsin, China. With two side spans the total length between abutments will be 306 ft. Pneumatic caissons will be sunk for the foundations of the two piers. A 40-ft. roadway between the trusses will have the central 20-ft. strip, for a double-track electric railway. Cantilever brackets 9 ft. long outside the trusses will carry a 5-ft. roadway for ricksaws and a raised 4-ft. sidewalk. Creosoted wood blocks on planking will be used for the roadway on the lift span, while the sidewalks and rickshaw paths will be of reinforced concrete. The approaches will have a concrete slab covered with tarred macadam on the roadway and given a cement finish for the paths and sidewalks. The lift span will be operated by electric motors and the machinery is designed to handle it against a wind of 50 m.p.h. Foundation work will be carried on during the coming winter and it is expected to have the bridge ready for traffic in 1926.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

A Contractor on Underestimating

Sir—Referring to the editorial on p. 776, *Engineering News-Record*, Nov. 13, 1924, entitled "Ethical Aspects of Underestimating," it is well that the ethical and moral phase of underestimating by engineers is being taken under advisement by engineering societies.

Underestimating is unfair competition. Engineers are called in to submit plans and estimates of cost for a specific project. One engineer will cut the quantities, which actually do exist, and his proposition will appear to be a saving of money to the principal. In this manner the unethical engineer secures an unfair advantage and often is engaged for the work.

But the serious injury of underestimating is not one of ethics or morals. There is often a question of financial loss involved, caused by misinformation advanced by virtue of underestimating. The dimensions and quantities furnished by the engineer comprise the information the bidder uses in preparing his estimate of equipment and the method which go to establish his cost. Upon this bid a contract is awarded, operations are started and in the course of progress dimensions and quantities work out so differently as to effect changes in equipment, method and time required to complete the project. Equipment, method and time govern expense and when underestimating is the direct cause of changes in these items the engineer and his client should be responsible for the financial loss involved.

If the American Association of Engineers can effect a higher moral and ethical standard for its members it will do much to increase harmony and prosperity for principal, engineer and contractor.

A. W. HINAMAN,
Contractor.

Mansfield, Pa.
Nov. 22, 1924.

Ice Shove on High Bridge Piers

Sir—In *Engineering News-Record*, Nov. 6, p. 757, there appears an article about high bridge piers recently built in Kentucky. Since these piers are to be submerged, presumably to within a few feet of their tops, it would be interesting to the writer to know something about the allowance made for ice-pressure. If ice is formed to any extent, and sets up a lateral pressure not equal on all sides, a lever-arm of 200 odd feet would produce a moment at the base that might be very great.

T. E. MOSS WHEAT,
Civil Engineer.

Detroit, Mich.,
Nov. 13, 1924.

Roots in Vitrified Pipe Line of Flagstaff Water-Works

Sir—I was much interested in the account of the additional water supply for Flagstaff, Ariz., by R. F. Baldwin, in your issue of Sept. 25, p. 496, as the Santa Fé Ry. constructed much of the present system and is interested in the proposed new work from the standpoint of a user of a majority of the water.

While the description is generally correct, there is one point which I think is unduly emphasized, and that is the trouble which has been experienced with roots growing through the joints of the vitrified pipe lines. I am advised by an official of the town of Flagstaff that the annual cost during the last five years for the maintenance of both of these pipe lines has been in the neighborhood of $400, and it seems to me that, as the length of the two lines together is 30 miles, this annual cost is exceedingly small. There has been no depreciation in the line laid in 1898 nor has there been any in the one laid in 1914.

While it is true that asphalt coated steel pipe of light section have also lasted for many years at the [illegible] road works, I do not think that the impression should be given that vitrified pipe lines have been a failure. In fact it is probable that when the new line is constructed, the old lines will be retained for standby service.

GEORGE L. DAVENPORT, JR.,
Assistant Engineer, A. T. & S. F. Ry. Co.

Los Angeles, Calif.,
Nov. 5, 1924.

Esthonia Subsidizes Home Building

Sir—In your issue of July 3, 1924, p. 11, there is published a short article about housing shortage in Denmark. The same calamity prevails in the Baltic border states, especially Esthonia.

It may be of interest that in July, 1922, the Esthonian government authorized the sum of 258,900,000 marks to be given in the form of building loans at equal rates during the three years 1922-1924. Such loans were to be given in cities only up to 70 per cent of the estimated cost, provided the local city assembly guarantees 1/7 of the sum given by the government. The rate of interest is 2 per cent per annum (five times lower than the discount of the Eesti Bank). The sums are to be refunded by equal payments during 30 years, if given for wooden houses, and during 40 years for stone ones. Restrictions are severe as to the type of buildings to be subsidized, floor area, number of rooms allowed, etc.; even the rent for rooms to be let in those houses is fixed by a specially appointed committee, and the owner is allowed to gain from his capital invested 2-3 per cent less than he would earn on a fixed deposit in an Esthonian bank.

Early in the spring the rest of the granted sum was distributed and 100,000,000 marks additional were asked for by two cities. With the aid of these subsidies 406 houses have been built, containing 1,038 lodgings or 2,540 living rooms.

H. SEYDENBACH,
City Engineer.

Tartu, Esthonia,
Oct. 24, 1924.

Water Works Association Did Not Approve Standard Contract

Sir—In your issue of Nov. 13, 1924, p. 796, in the article on the proposed standard contract form, you stated that the American Water Works Association had approved the second draft of the standard contract form as a statement of principles.

This is not correct, as all the association has done was to approve at its last annual meeting the printing of the documents for the information of the members. Neither the principle of arbitration nor the documents themselves have yet been presented for formal discussion.

J. WALDO SMITH,
Chairman, Standard Form of Contract Committee,
American Water Works Association.

New York City,
Nov. 24, 1924.

Traffic Accidents Decrease at Danger Point

Before the introduction of the improvement mentioned below the greatest danger point for street traffic accidents in St. Louis was at Washington and Grand Aves., said Harland Bartholomew, engineer of the City Plan Commission of St. Louis, in a recent paper before the National Safety Council. These "two busy thoroughfares intersected, but with an offset of about 300 ft.," thus requiring "east and westbound traffic on Washington Ave. to make a turn into Grand Ave. and then turn out again 300 ft. further on." A "cutoff was made and Washington Ave. widened" so as to provide an approximately right-angled intersection. The cost was some $200,000, but since the improvement "traffic accidents have been tremendously reduced," said Mr. Bartholomew.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

George T. Seabury Elected Am. Soc. C. E. Secretary

Manager of Providence Safety Council Made Successor to the Late John H. Dunlap

George T. Seabury, manager of the Providence (R. I.) Safety Council, former division engineer of the Providence Board of Water Supply, and prominent in engineering society activities in that city, has been elected secretary of the American Society of Civil Engineers. Mr. Seabury was named to fill the position, left vacant through the death in July of John H. Dunlap, at a meeting of the Board of Direction of the society held in Pittsburgh Dec. 1.

Mr. Seabury is a civil engineering graduate of Massachusetts Institute of Technology, class of 1902. After graduation he entered the service of the Rapid Transit Subway Construction Co., New York City. When, as an assistant engineer, he left that company in 1902 he became associated successively with the O'Rourke Engineering and Construction Co., the United Engineering & Contracting Co., J. C. Rodgers as engineer on the extension of Riverside Drive, and the City Wastes Disposal Co.

WITH N. Y. BOARD

In 1906 Mr. Seabury became an assistant engineer in the New York City Board of Water Supply. During such service he was on the chief engineer's taff as general inspector making studies and reports, and from 1910 to 1914 was first assistant to the division engineer in charge of the construction of the Kensico Reservoir, effluent works and the Kensico Dam.

In 1914 Mr. Seabury formed an association with Albert A. Northrop to engage in consulting practice. However, he was called to Providence in 1915 to the water-supply board where he remained until 1918, entering the military service as a major in the Construction Division. As supervising construction quartermaster he was connected with the construction of the following Army camp: Devens, Upton, Mills, Merritt, Dix, Meade and Lee.

After the war, Mr. Seabury organized the firm of George T. Seabury, Inc., and for four years engaged in highway construction until in March, 1923, he was appointed manager of the Providence Safety Council, which position he leaves to become secretary of the Am. Soc. C. E.

Mr. Seabury has been an active figure in society affairs in Providence, being the vice-chairman of the Providence Section of the Am. Soc. C. E. and an active committee worker in the Providence Engineering Society. He was elected an Am. Soc. C. E. junior in 1903, an associate member in 1908, and a member in 1913.

Engineer Lobbyist Proposed

The Minnesota Federation of Architectural and Engineering Societies has authorized its legislative committee to employ an engineer to watch the progress of bills in which the Federation is interested during the coming session of the state legislature. The engineer selected is to be familiar with the work. A preliminary appropriation of $200 was made and the committee was instructed to determine what amount will be required.

Canadian Boards of Trade Urge St. Lawrence Development

The Associated Boards of Trade of Ontario, at their annual convention in Toronto, adopted a resolution urging that all boards of trade and chambers of commerce in the province lend their influence toward securing a united public opinion in favor of the immediate development of the St. Lawrence power, "and in support of the government in its efforts to prevent the continued diversion of water power from the great lakes system at Chicago, as no development of the St. Lawrence river can or should take place until this question is settled."

Freeman Becomes Chief Engineer of Tunnel Commission

Milton H. Freeman, acting chief engineer of the commissions now building the Hudson River vehicular tunnel, has been appointed chief engineer to succeed the late Clifford M. Holland. Mr. Freeman is a native of New York State and a graduate of Michigan University. He has been in tunnel work for nearly twenty years, starting on the East River tubes of the Pennsylvania R.R. between 1905 and 1909. He then served with the Board of Water Supply on the Rondout Siphon and the Narrows Siphon from 1909 to 1914, and on subway tunnels under the East River until he joined the staff of the vehicular tunnel commission.

New Bids for Trenton Sewage-Works Slightly Lower

Bids for sewage-works at Trenton, N. J., on Nov. 28 were slightly lower than those received Oct. 31 and subsequently rejected, as noted in these columns, Nov. 13, p. 806, on the allegation that the lowest bid was unbalanced. The later bids were: J. P. White Co., Passaic, N. J., $1,022,107; J. L. Sigretto (the lowest bidder Oct. 31) Bernardsville, N. J., $1,056,775; M. Staub & Koln Construction Co., New Brunswick, N. J., $1,075,410. The estimate of the engineers, George A. Johnson and George L. Watson, New York City, was $1,124,515.

George Chandler Whipple Dies Suddenly

Harvard Professor, Consulting Engineer, Author, Succumbs Suddenly To Heart Attack

George Chandler Whipple, professor of sanitary engineering at Harvard University and member of the firm of Hazen & Whipple, consulting engineers, New York City, died suddenly from a heart attack at his home in Cambridge, Mass., on the morning of Nov. 27. Funeral services were held at the Appleton Memorial Chapel, Harvard University, on Sunday afternoon, Nov. 30.

Professor Whipple was one of the many students at the Massachusetts Institute of Technology who became imbued with the love of sanitary science and public health under the inspiring leadership of William T. Sedgwick, and who benefited by the instruction of William Ripley Nichols and Thomas M. Drown in sanitary chemistry. Early in his career and for many years afterwards Whipple did notable work in water biology and as director of water analysis laboratories. He made a reputation as teacher and lecturer before beginning his work at Harvard and at both that institution and at the Harvard-Technology School of Public Health he rapidly established the same personal relations with his pupils as did Professor Sedgwick through his longer teaching career.

Mr. Whipple was born at New Boston, N. H., March 2, 1866, but at three years of age he went with his parents to Chelsea, Mass. He graduated in civil engineering from M.I.T. in 1889 and immediately afterwards began his teaching career as assistant in the M.I.T. Summer School of Engineering. During his college vacations he had served as assistant to Frank L. Fuller, a leading Boston engineer engaged in municipal work, and had conducted sanitary investigations under Prof. Dwight Porter as inspector of tenement houses for the Boston Associated Charities.

Directly after the teaching work just mentioned Mr. Whipple came under the direction of Desmond FitzGerald, who as superintendent of the western division of the Boston Water-Works, in charge of storage reservoirs, had been doing some of the earliest American work on micro-organisms in potable waters, besides pioneering also in the sanitary protection of public water supplies. Young Whipple took up his work in October, 1889, at what soon became widely known as the Chestnut

Hill Laboratory of the Boston Water-Works, where, except for the short period named below, he was biologist in charge until May, 1897. The laboratory was located close by the Chestnut Hill reservoir, in the town of Brookline, and not far from the office of F. F. Forbes, then and still serving as superintendent of the Brookline water-works. Mr. Forbes, like Mr. FitzGerald and also like the late George W. Rafter, a consulting engineer at Rochester, N. Y., was one of the pioneers among water-works engineers in the microscopical study of drinking water.

While at the Chestnut Hill laboratory, Whipple was for three years consulting biologist to the city of Lynn. During the brief absence from the laboratory already mentioned (Oct., 1896, to March, 1897), he served as assistant to Prof. Albert R. Leeds, of the Stevens Institute of Technology, on a study of the water supply of Brooklyn, N. Y. This connection led to Whipple's resignation of his Boston position, where he had organized the first great water laboratory in America, to enter upon the founding of what now is presumably the largest municipal water laboratory in the world, probably closely rivalled only by the laboratory of the Metropolitan Water Board of London, the latter under the direction of Sir Alexander Houston. The Brooklyn laboratory was and still is located close by the Mt. Prospect reservoir, from which it is named. Whipple began work there as director about the middle of 1897 and continued until 1904, taking charge of the examination of all the water supplies of Greater New York after the consolidation of 1900. In 1903, as one of the department engineers of the Commission on Additional Water Supply for New York City, Whipple made an extensive investigation of all the sources of water supply considered available for New York City, including the Catskill, the one finally adopted.

Entered Private Practice in 1902

In 1902 Whipple definitely entered private engineering practice, more particularly in 1904, when he began his twenty years of association with Allen Hazen, under the firm name of Hazen & Whipple, New York City.

In 1911 Whipple became Gordon McKay Professor of Sanitary Engineering at Harvard University and went to Cambridge to live although still retaining his membership in the firm Hazen & Whipple. Later he delivered lectures at the Thayer School of Engineering, and also at the M.I.T., with either series or occasional lectures at many other places, and from 1907 to 1911 was professor of water supply at the Brooklyn Polytechnic Institute.

Besides his Harvard professorship, Whipple helped organize the Harvard-Technology School of Public Health in 1913 and served as its secretary until the school came to an end with the opening of the Harvard School of Public Health in 1922.

From 1914 to 1923 he was a member of the Massachusetts Public Health Council and chairman of its Committee on Sanitary Engineering. During those nine years, according to a letter which he wrote to *Engineering News-Record*, at the close of the period, Whipple declined professional engagements in Massachusetts as inappropriate for one holding the public office he did; he also stated, in the letter mentioned, that the private work, of which he hoped to do more after his resignation, would be done in association rather than in competition with other engineers as it seemed to him that "this should be the true attitude of a college professor toward his engineering colleagues.

From 1912 to 1916 Whipple was chairman of the Sanitary Commission of Cambridge and from 1913 to 1916 he was a member of the New York City Committee on Building Districts and Restrictions which worked out the first comprehensive zoning plan for an American city. He also had a commission as senior sanitary engineer, U. S. Public Health Reserve, with the grade of assistant surgeon-general.

Foreign Service in Sanitation

Foreign service by Whipple in the field of sanitation and public health began in 1917 when he went to Russia as major and deputy commissioner in the American Red Cross. In 1920 he went to Geneva, Switzerland, as a chief of the Department of Sanitation in the League of Red Cross Societies. While serving in that capacity he made a study of typhus fever in Roumania.

Early in his career Whipple began what proved to be a long series of contributions to the literature of water supply and public health: First, papers and addresses, which he took care to have printed and circulated; later, books which soon became standard texts or references. The books were: "The Microscopy of Drinking Water," first published in 1899 while Whipple was at the Mt. Prospect Laboratory, Brooklyn; "Typhoid Fever" and "The Value of Pure Water," two small but significant books; "State Sanitation," two volumes which reviewed the work of the Massachusetts State Board of Health and contained abstracts of notable contributions to public health literature by its members and staff; "Fresh Water Biology" (with Dr. Ward) and "William Thompson Sedgwick, a Pioneer in Public Health" (with C.- E.A. Winslow and E. O. Jordan). Most of Whipple's valuable contributions to engineering reports are merged with the work of other members of the firm of Hazen & Whipple but special mention may be made of his studies of typhoid fever and water supply at Cleveland, Ohio, of sewage disposal with special relation to trades wastes at Paterson, N. J., of the Rockaway River as a source of water supply for Jersey City, of stripping organic matter from reservoir sites, and of his joint report on sewage disposal at Milwaukee, with John W. Alvord and Harrison P. Eddy. The proceedings of the various engineering and other technical societies bear witness to Whipple's valuable work on committees and as a contributor of papers and participant in discussions. Abroad he was an honorary fellow of the Royal Sanitary Institute and a fellow of the Royal Microscopical Society of London.

Professor Whipple is survived by his wife, a married daughter and a son, the latter a student at Bowdoin College.

Hetch Hetchy Work Goes On Despite Controversy

Acting Mayor Orders Work Stopped. But Taxpayer's Suit Enjoins Discontinuance Order

Within the past ten days the San Francisco board of supervisors has given much attention to the Hetch Hetchy water supply project and on Nov. 24 Ralph McLeran, the acting mayor and chairman of the finance committee of the board of supervisors, ordered the board of public works (city council) to discontinue work on certain parts of the project where about 500 men are employed. (The total force now on the project is about 1,000 men). This order would have been carried out had it not been for an injunction secured by a taxpayer to hold up the stop order. Pending court action on this injunction the construction is continuing with full crews.

Mr. McLeran, while Mayor Rolph was out of the city, brought before the board of supervisors figures to show that the 1910 bond issue for $45,000,000 was practically exhausted and that there were insufficient funds for completing the mountain division. In addition to the order to stop work, the acting mayor endeavored to secure the passage of an ordinance repealing the 1913 ordinance that gave the city engineer complete authority to make plans, let contracts and purchase materials for "the acquisition, construction and completion of the municipal water supply." This endeavor had been unsuccessful up to Dec. 1. Mayor Rolph, who was in Boston while the board had this action under consideration, is understood to be opposed to any Hetch Hetchy shutdown.

Cause of Differences

The fundamental difference between the acting mayor and the city engineer seems to be in the allocation of moneys received (1) from the sale of power from the Cherry Creek plant and (2) from operation of the Hetch Hetchy railroad. "Money received from these two sources," M. M. O'Shaughnessy states, "amounts to $1,500,000 from which we got back only $300,000, so there is $1,200,000 from these sources that should be credited to the project." Mr. McLeran asserts that this fund has been built up for seven years past as an operating revenue fund and should be reserved for use in paying bond interest.

In an interview with a representative of *Engineering News-Record*, Mr. O'Shaughnessy said that taking into account the railroad earnings, proceeds from power sales and salvage on construction equipment, there are still ample funds available from the 1910 bond issue for the completion of the mountain division. To stop the work just at this time would cause extensive and wholly unnecessary waste due to the disorganization of crews in camps that are on the point of finishing up their work, not to mention the loss of materials at the Early Intake diversion dam and other losses that would attend a sudden and unexpected shutdown.

John Lyell Harper, Niagara Falls Power Co. Executive, Dies

John Lyell Harper, vice-president and chief engineer of the Niagara Falls Power Co., died at his home in Niagara Falls, N. Y., on Nov. 28, following an operation for appendicitis performed earlier in the week.

Mr. Harper was born in Harpersfield, N. Y., in 1873 and graduated from Cornell University in 1897 with the degree of M.E. Following his graduation he was in the employ of various public utilities in the Northwest until in 1902 he entered the employ of the Niagara Falls Hydraulic Power & Manufacturing Co. as an assistant engineer, becoming chief engineer in 1903. Since that date Mr. Harper has been an outstanding figure in all matters concerning the scenic and hydraulic development of Niagara Falls.

During the twenty-one years that Mr. Harper was chief engineer of the Niagara Falls Hydraulic Power & Manufacturing Co. and its successor the Niagara Falls Power Co., much has been done to increase the output of the power plants and at the same time to replace ugly structures in the Niagara Gorge with buildings which blended with their surroundings. In recent years Mr. Harper has been active in the study of means to reduce the erosion of the center of the Horseshoe Falls which is now threatening the beauty of the whole Falls.

A measure of the improvements in hydraulic developments of Niagara Falls since Mr. Harper became chief engineer of the power company may be found in the fact that the three new 70,000-hp. turbines develop 210,000 hp. with the same amount of water that heretofore developed only 115,000 hp.

In addition to his duties with the power company Mr. Harper made numerous investigations for the electrochemical and electrometallurgical industries at Niagara Falls and developed several electric furnaces.

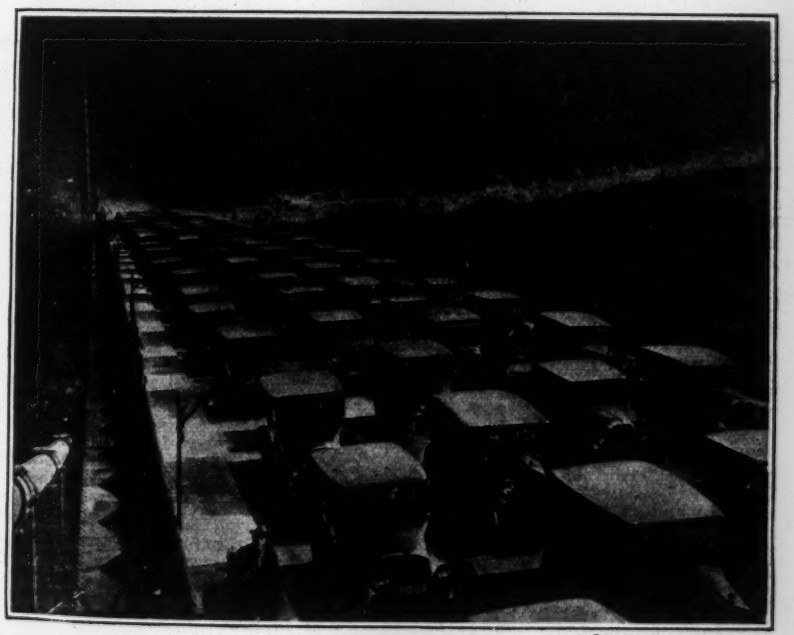
Less than a year ago Mr. Harper associated himself with H. Birchard Taylor and others to form the firm of Harper & Taylor, engineers, Mr. Harper retaining his position as vice-president and chief engineer of the Niagara Falls Power Co.

Intimation Given Government May Approve Golden Gate Bridge

The San Francisco association which is promoting the plan for bridging the Golden Gate has received a letter from the Chief of Engineers, U. S. A. at Washington, D. C., which says, in referring to the application for permission to construct this bridge, "I would inform you that this department looks on the proposition favorably and the Navy Department has no objection to the proposed construction. Consideration is now being given to the question of replacing structures affected by the piers and approaches of the proposed structure. As soon as this can be cleared up, the department hopes to act favorably in the matter."

The public hearing in San Francisco on this proposal before Colonel Herbert Deakyne, Corps of Engineers, U. S. A., was reported in *Engineering-News Record*, May 29, 1924, p. 951.

Bear Mountain Bridge Opened to Traffic Nov. 27



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Photograph taken during the Thanksgiving Day ceremonies. An article on the design of the bridge can be found on p. 914-918 of this issue.

Sir Maurice Fitzmaurice, Noted Engineer, Dead

Assouan Dam Builder, Honorary Member of Am. Soc. C. E., Dies in London

Sir Maurice Fitzmaurice, consulting engineer of London, and honorary member of the American Society of Civil Engineers, died Nov. 17, aged 63 years. His chief works were the Assouan Dam in Egypt, and bridges, tunnels and main drainage works of London. Sir Maurice took his engineering degrees at Trinity College, Dublin, and served his articles under the late Sir Benjamin Baker. He was engaged on the construction of the Forth Bridge, railways and docks in Canada and of the Blackwell tunnel.

His first big appointment was chief engineer to the Egyptian Government on the building of the Assouan Dam on the Nile, which was designed by Sir W. Willcocks. For this work Sir Maurice received the Order of the Medjidieh of the Second Class and the Companion of the Order of Saints Michael and George in 1902. At 40 years of age he was chief engineer to the London County Council. On retirement he joined the firm of Goode, Fitzmaurice, Wilson and Mitchell, consulting engineers for harbors to the crown agents for the Colonies, and to the Sudan Government for the Blue Nile Irrigation Works.

Sir Maurice was knighted in 1912 when the King laid the foundation of the new London County Hall. His other works were the duplication and extension of the whole main drainage system of London at a cost of £4,000,000, the construction of the Rotherhithe tunnel, Vauxhall bridge, and the subway from the Embankment to Holborn for the underground trams.

In 1913 Sir Maurice advised the Australian Government on the construction of naval harbors and works; during the war he was chairman of the admiralty advisory committee on naval works and chairman of the War Office on civilian labor. He advised on the question of drainage on the French front. Other posts held by him were chairman of the Nile Projects Committee, chairman of the Canal Control Committee, chairman of the Treasury Committee on Aerodrome Accounts, member of the Advisory Council on Scientific and Industrial Research, Royal Commission on Fire Prevention, and Advisory Council of the Science Museum.

He was one of the few engineers admitted to the fellowship of the Royal Society; in 1916-1917 he was president of the Institution of Civil Engineers; he was an honorary member of the American Society of Civil Engineers, an honorary fellow of the Society of Engineers and the Royal Engineers' Institution, a member of the Institution of Mechanical Engineers and of the Engineering Institute of Canada.

Contractor and Architect to Co-operate

National Organizations Take First Steps To Study Jointly Basic Problems of Construction

A step forward toward improved practices in the building industry was taken at Detroit, Nov. 20, at a luncheon attended by the executive committees of the American Institute of Architects and the Associated General Contractors of America, at which a resolution was passed looking toward joint action by the two organizations on problems of mutual concern.

The luncheon, tendered by F. L. Cranford, president of the A.G.C., and attended by about 75 members of the two organizations, was marked also by the announcement of D. E. Waid, president of the A.I.A., that the executive board of that association, meeting the previous day at Ann Arbor, had voted to issue as the fourth edition of the A.I.A. contract practice the uniform building contract evolved by the joint conference some months ago.

Co-Operation Pledged

Mr. Cranford, Mr. Waid and Gen. R. C. Marshall, Jr., general manager of the A.G.C., discussed briefly problems of the industry which are of mutual concern to the constructor and to the architect. The theme was summarized by General Marshall, in the course of his statement, in these words:

"It is the desire of the constructing group as represented by the Associated General Contractors of America that the architectural profession undertake jointly with it a study of the various economic, construction and ethical problems with the object in view that waste and dissension in the building industry be minimized and that client-owners may be given the highest possible standard of service."

General discussion ensued regarding specific problems of joint concern, including service and division of responsibility, surety bonds, day-labor construction, contract forms, labor disputes and means of strengthening the National Board for Jurisdictional Awards, and the proposed federal department of public works.

After the conference had adopted a resolution expressing its sense that a number of questions of mutual concern should be determined by joint action, the presidents of the two organizations, Messrs. Cranford and Waid, were asked to get together and decide upon a necessary number of specific committees to handle various topics considered timely in this connection, and to appoint committees from their respective associations for joint work.

Bids Asked on Pittsburgh Bridges

Sealed proposals will be received at the office of the county controller of Allegheny County, Pa., until Dec. 22, for construction of the superstructure of bridges 2, 3 and 4 across the Allegheny River, known as Sixth St., Seventh St., and Ninth St. bridges, respectively.

Blaine S. Smith Elected President of Portland Cement Association

Blaine S. Smith, general sales manager of the Universal Portland Cement Co., Chicago, was elected president of the Portland Cement Association at its annual meeting in Chicago, Nov. 17-19. Mr. Smith started his business career in the general freight department of the Chicago and Northwestern Ry. Co. at Chicago, where he served for a number of years before becoming a salesman for the Universal Portland Cement Co. in 1908. From salesman he advanced through several positions to that of general sales manager in 1915, which position he still holds and in which he is credited with developing one of the most successful selling organizations in the country.

Mr. Smith has served on various committees of the Portland Cement Association. During the last three years he was chairman of the committee on advertising and publicity and for the last two years was vice-president and a member of the board of directors. For many years Mr. Smith has been identified with the Chicago Association of Commerce where he served as vice-president, as member and chairman of a number of committees, and at present is a member of the board of directors. He also is a member of the board of directors of the Illinois Chamber of Commerce.

Mr. Smith is a member of the American Society for Testing Materials, American Concrete Institute, Western Society of Engineers, U. S. Chamber of Commerce, Chicago Athletic Association, Union League Club and Exmoor Country Club.

International Railway Congress To Be Held in London in 1925

Announcement has been made that the International Railway Congress will be held in the houses of the Institution of Civil Engineers and Institution of Mechanical Engineers in London, June 22 to 26, 1925, with excursions to other part of Great Britain extending through July 6. The permanent office of the Congress is 17 Rue de Louvain, Brussels, Belgium.

Gandy Toll Bridge Opened

On Nov. 20 the Gandy Bridge, a six-mile structure (including approaches) across the mouth of Old Tampa Bay, Florida, was opened to the public. The structure consists in the Pinellas approach (2⅞ miles long), the main bridge which is a series of reinforced-concrete arches (2½ miles long), and the Hillsboro approach (⅝ mile long). The total cost of the bridge was approximately $3,000,000. Work was begun in 1915, but actual construction has been confined to the past two years. The structure shortens by many miles the distance from Tampa to St. Petersburg.

Random Lines

Some Use After All

We see by the papers that an "efficiency engineer" down Philadelphia way has gotten away with a hundred thousand or so of the firm's money. Sooner, or later, we always knew, we would find out what those fellows were good for.

* * *

The Buying Power of Religion

It is now estimated that at least 45,000 pilgrims left Java this year on the Mohammedan pilgrimage to Mecca, according to cable advices to the Department of Commerce. This is an exceedingly high number and probably means a reduction of 45,000,000 guilders in the native spending capacity, or about 10 per cent of the total value of 1923 imports.—*Commerce Reports.*

* * *

Winter Construction!

IF WE ALL DON'T GET OUR SHARE THIS YEAR IT WON'T BE BECAUSE THE TURKEY ISN'T BIG ENOUGH

Darling, in the New York *Tribune*

* * *

Pre-Natal Influence

Sir—A few years ago an electric light plant was to be built under contract with a municipality in Nicaragua — there were as yet none in the country. One of the natives, better educated in argumentation than honesty in England, had a dam and reservoir near by that he was offering the municipality as a power site; his competitor was submitting a Diesel plant. Our friend reasoned with the council of "Wise Men," thus:

"As you know I have traveled in Canada, Europe and the United States. I have always noticed that wherever they make their electricity by fire the lights are red like fire; but where the electricity is made by water you have whitish lights like stirred-up water. Now we want the best lights our money can buy. And I submit that my proposition is much better for us than is Sr. Gonzales'."

The comparison was so obvious that "White Lights" won. R. Z. K.

Engineering Societies

Calendar

Annual Meetings

ADVISORY BOARD ON HIGHWAY RESEARCH, Washington, D. C.; Annual Meeting, Washington, Dec. 4-5, 1924.

AMERICAN ROAD BUILDERS ASSOCIATION, New York City; Annual Convention, Chicago, Ill., Jan. 5-9, 1925.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual Meeting, Washington, D. C., Jan. 12-14, 1925.

AMERICAN ENGINEERING COUNCIL, Washington; Annual Meeting, Washington, D. C., Jan. 16, 17, 1924.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Meeting, New York City, Jan. 21-23.

ENGINEERING INSTITUTE OF CANADA, Montreal; Annual Meeting, Montreal, Jan. 27-29, 1925.

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; Annual Meeting, Chicago, Ill., Feb. 24-27, 1925.

The Western Society of Engineers, Dec. 8, will hear a full discussion of the South Water Street improvement, including traffic studies and construction details, by John J. Sloan, president, Board of Local Improvements and T. A. Evans, engineer of design. On Dec. 29 a description of the 300-m.g.d. Western Ave. pumping station will be given by Loran D. Gayton, engineer of waterworks design. It will include a discussion of the extensive studies made of the relative economy of steam and electric pumping.

Personal Notes

ORVILLE A. LOOMIS, St. Joseph, Mo., has been appointed surveyor for Buchanan County, Missouri, succeeding JOHN S. WHITEHEAD, resigned.

F. E. WEYMOUTH, who recently resigned the office of chief engineer in the U. S. Reclamation Service, has become president of Brock & Weymouth, Inc., an organization with offices at 1607 Walnut St., Philadelphia. Mr. Weymouth graduated from the University of Maine in 1896 and since that time has been actively engaged in engineering work. His experience in waterworks, Nicaraguan canal surveys and railroad development in South America led to his selection for the staff of the Reclamation Service when it was formed in 1902. He carried out a number of government irrigation projects, including the Arrowrock Dam, among the highest in the world, constructed under his leadership for a million dollars less than the estimated cost. This success led to his appointment as chief engineer, in which position he has for years supervised engineering work in fifteen states of the West. Brock & Weymouth has been organized to furnish information for scientific studies of engineering projects, and for this purpose will utilize the Brock patented aerial process and equipment in making topographic maps, a process by which contours can be rapidly and accurately drawn on maps from photographic information.

ED R. NEFF, county engineer of Bradford County, Florida, has been appointed city engineer of Miami Beach, Fla., and will take over the engineering portion of the work heretofore handled by VAN ALEN HARRIS as city manager. Mr. Neff was assistant city engineer of Jacksonville, Fla., from 1912 to 1919, and following that was resident engineer for the city of Durham, N. C.

J. H. KIMBALL, formerly assistant chief engineer for the Miami Conservancy District, Dayton, Ohio, is now located at Cumberland, Md., where he is making investigations looking toward flood protection measures for that city. A. F. GRIFFIN, formerly division engineer for the District at Troy, Ohio, has gone with Mr. Kimball to Cumberland.

Obituary

GEORGE SEIBEL, a member of the contracting firm of Seibel Brothers Construction Co., Manchester, Mo., died at his home in that city Nov. 7, of heart disease; he was 51 years of age.

HARRY E. ABRY, for the past two years valuation engineer for the Oregon State Railway Commission, died at his home in Salem, Ore., Nov. 14, at the age of 58 years. In his service as executive in engineering works, Mr. Abry had held the positions of chief engineer of the Lytle roads, assistant chief engineer on construction of the Columbia River highway, and state highway engineer of Oregon. Previously he had been county engineer of Multnomah County, Oregon, and before going to Oregon had been in railroad service, his home being at Leavenworth, Kan.

LEROY TALLMAN, works manager on the New Jersey side of the Hudson River vehicular tunnel, died Nov. 30 at his home in Malba, Long Island. Mr. Tallman was born in Portsmouth, R. I. His first work in the engineering construction field was as assistant engineer for the water department of Newport, R. I. Later he was engaged on the building of the water-works for Newton, N. J. His first work on tunnel construction was on the Pennsylvania R. R. 33rd St. tunnel, in the forces of the O'Rourke Engineering and Construction Co., which was followed by service as engineer in charge of the caisson foundations of the building now known as 30 and 50 Church St., New York. The next construction in which Mr. Tallman served was the Baltimore, Md., sewage system, as superintendent for the M. A. Talbot Co. Other works were the Degraw St. tunnel for the John Pierce Co., and the Long Island City approach to the Queensboro bridge for Snare & Triest. For fourteen years he has been connected with Booth & Flinn, first as superintendent for the Pittsburgh Contracting Co., directed by Booth & Flinn, and later in the Booth & Flinn organization on sewer tunnels in Brooklyn, in Detroit and Toledo, the Clark St. subway tunnel in New York City, and since construction started, the Hudson River tunnel.

HUBERT E. LARKIN, engineering contractor of St. Catharines and Buffalo, N. Y., was recently found dead in the cabin of a yacht on which with a friend he was journeying in the New York Barge Canal near Seneca Falls, N. Y. Mr. Larkin was born in St. Catharines in 1875. Early in life he entered the contracting firm of Larkin, Sangster, Inc. Among the more important of the engineering works on which he was engaged were the enlargement of the Galoupe Canal, a part of the St. Lawrence system near Iroquois, Ont., the government elevators at Port Colborne, the power canal for the Cataract Power Co. at Hamilton, Ont., the power house for the Ontario Power Co. at Niagara Falls, and a section of the Trent Canal. In the United States he was engaged on the construction of a section of the New York Barge Canal locks, the lock and dam at Seneca Falls, and the Galveston Causeway in Texas.

ALFRED F. BRIDGMAN, civil engineer, died Nov. 25 at his home in Hyde Park, Mass., aged 67 years. Mr. Bridgman was born in Springfield, Mass., and took a course in civil engineering at Massachusetts Institute of Technology. In the 80's he assisted in laying out the Tuxedo Park Reservation in New York State. In 1890 he became purchasing agent and auditor of the Metropolitan Sewage Commission and later of the combined Metropolitan Water and Sewerage Board, of Boston, and continued in that position when this board was merged with the Metropolitan Park Commission as the Metropolitan District Commission. He retired from active service on Aug. 1, 1923.

ORVILLE BENSON, of the American Bridge Co., assistant to the division engineers in the Pittsburgh and New York offices, died at Pequannock, N. J., Oct. 19, aged 59 years. Mr. Benson was a native of Connecticut. He was graduated from Cornell University in 1888 in civil engineering He was bridge engineer with the Wrought Iron Bridge Co. of Canton, Ohio, until 1898 when he entered the Spanish-American War as a first lieutenant of engineers. After the war he saw short service with the Edison Concentrating Works and then in 1902, entered the organization of the American Bridge Co., occupying the positions of engineer of the plants at Canton, Ohio, and East Berlin, Conn., and since then the positions named above. During the World War Mr. Benson served two years in France as major in both engineer and artillery units.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Gain in Glass Production Reflects Exceptional Building Activity

"Every commodity closely linked with the building industry has shown greatly increased production in the past three years," states the National Industrial Conference Board. Investigations by the Board based on preliminary data of the 1923 Census of Manufactures, reveals the following: "The 1914 production of all except two of the commodities listed exceeded the 1919 output. From 1919 to 1921 only one commodity showed an increase in production while in 1923 all of the commodities exceeded the highest production records for previous census years.

"A very large increase in plate and window glass production since 1921 is a direct reflection of the exceptional building activity during this period. More than a quarter of a million square feet of window glass was produced in 1923 in excess of 1921, production having risen over 110,000 ft. above the pre-war level of 1914. Polished plate glass shows an increase of 37,000 sq.ft. for 1923 over 1921 and is one-third greater in volume than in 1914. Obscured glass and rough-wire glass doubled their volume of output over the same period.

"Average factory prices representing the selling value at the factory revealed that all products except two showed a decrease in price from the 1919 level, a remarkable fact in view of the pressure of demand for all types of glass and considering that the average cost of labor in this industry was 88 per cent higher in 1923 than in 1914. The "cost" of labor in this case is the amount paid by the employer for a given time unit of labor, in other words, the cost of an average wage earner month. There was an increase in the number of wage earners in the glass industry from 1921 to 1923 of over 20,000 workers."

Mixer Manufacturers Pledge Support to Standards

As a further step toward making effective the standards for concrete mixers adopted by the Mixer Manufacturers Bureau of the Associated General Contractors, the following conditions of sale are required to be agreed upon as a preliminary to the furnishing of name plates for standard machines:

"(1) Our company will not represent in its literature or otherwise, or knowingly permit any salesman or agent to represent that any mixer designated by one of the standard sizes will deliver a batch of mixed concrete greater than that indicated by the A. G. C. name plate corresponding to such size.

"(2) Should our company abandon or violate the concrete mixer standards approved by the meeting of mixer manufacturers at the Old Colony Club, Chicago, May 1, 1924, or any future modification thereof, the Associated General Contractors have the right, without incurring any liability, to refuse to supply us with name plates.

"(3) Should we decide to depart from the above mentioned standards, we will notify the Associated General Contractors before so doing."

Order 4,000 Name Plates for Standard Concrete Mixers

The eleven concrete mixer manufacturers constituting the Mixer Manufacturers Bureau of the Associated General Contractors have ordered 4,000 A. G. C. name plates to be attached to their machines as evidence of conformity with the standards adopted this year. The companies which have ordered the name plates are: American Cement Machine Co.; Archer Iron Works; Construction Machinery Co.; Koehring Co.; Kwik-Mix Concrete Mixer Co.; Lakewood Engineering Co.; Marsh-Capron Co.; Ransome Concrete Machinery Co.; Remmel Manufacturing Co.; T. L. Smith Co.; Jaeger Machine Co.

The plates are now being manufactured and will be shipped within a short time.

Cement Industry During 1923 Made Big Gain

The U. S. Department of Commerce announces that, according to the data collected at the biennial census of manufactures, 1923, the establishments engaged primarily in the manufacture of Portland, natural, puzzolan, and high-temperature cements in that year reported a total production valued at $285,050,551, an increase of 40 per cent as compared with $203,626,929 in 1921, the last preceding census year. The quantities and values of the principal products were as follows:

Portland cement, 137,460,238 bbl. valued at $278,732,025, an average of $2.02 per barrel.

Natural and puzzolan cement, 1,325,465 bbl. valued at $2,061,894, an average of $1.55 per barrel.

Of the 138 establishments reporting for 1923, 23 were located in Pennsylvania, 14 in Michigan, 12 in New York, 9 in California, 8 in Kansas, 7 in Ohio, 6 in Alabama, 5 each in Illinois, Indiana, Iowa, Missouri, and Texas, and the remaining 34 in 15 other states.

The statistics for 1923 and 1921 are summarized in the accompanying statement. The figures for 1923 are preliminary and subject to such correction as may be found necessary upon further examination of the returns.

STATISTICS ON THE CEMENT MANUFACTURING INDUSTRY 1923–1921

	1923	1921	Per Cent of increase a
Number of establishments	b138	125	10.4
Wage earners (average number) c	35,116	26,231	33.9
Maximum month	Aug., 37,462	Sept. 28,043	
Minimum month	Jan., 31,138	Jan. 22,198	
Per cent of maximum	83.1	79.2	
Wages	$49,740,985	$34,415,627	44.5
Cost of materials (including fuel and containers)	$121,333,894	$102,359,637	18.5
Products, total value	$285,050,551	$203,626,929	40.0
Portland cement:			
Barrels	137,460,238	95,507,147	43.9
Value	$278,732,025	$180,778,415	54.2
Average value per barrel	$2.02	$1.89	
Natural and puzzolan cement:			
Barrels	1,325,465	539,402	145.7
Value	$2,061,894	$897,025	129.9
Average value per barrel	$1.55	$1.66	
All other products, value	d$4,256,632	$21,951,489	−80.6
Value added by manufacture e	$163,716,657	$101,267,292	61.7
Horsepower	644,038	(f)	
Coal consumed (tons of 2,000 lb.)	8,444,609	(f)	

a A minus sign (—) denotes decrease.
b Comprises 126 establishments reporting Portland cement as principal product, 3 of which also reported natural cement; 7 reporting natural cement as principal product, and 5 reporting high-temperature cement.
c Not including salaried officers and employees nor proprietors and firm members. Statistics for these classes will be given in final report.
d Includes high-temperature cement valued at $535,501.
e Total value of products less cost of materials.
f Not reported.

Paving Brick Makers to Meet

The annual meeting of the National Paving Brick Manufacturers Association will be held in St. Louis, Mo., Jan. 21-23.

Business Notes

STOCKLAND ROAD MACHINERY CO., Minneapolis, manufacturer of blade graders, scrapers and dump wagons, announces the appointment of the Dominion Equipment & Supply Co., Winnipeg, Canada, as its distributor for the Manitoba territory. On Nov. 17-18 the company held a convention for

its distributors at the Congress Hotel, Chicago. The two-day session was presided over by J. D. Frazer, general manager, and C. T. McGrew, general sales manager, and was given over to a discussion of manufacturing and sales policies and the development of the company's business in the road-building field. The Stockland company recently established a New York office in the Knickerbocker Building, with F. L. Engels, Eastern sales manager, in charge.

WEBER ENGINEERING CORPORATION, New York, specializing in chimney construction, announces the opening of a Western office at 616 Wrigley Building, Chicago, with John Cargill in charge as Western representative. The company's chimneys are of reinforced concrete, constructed by means of a special sectional form. To date the company has built about 1,800 chimneys of all sorts in various parts of the world since its establishment 25 years ago by Carl Weber. The chimney built is known as the "Unilith."

HYMAN-MICHAELS CO., Chicago, due to its expansion in the railway equipment field, has engaged F. W. Glauser, formerly associated with the Mid-Continent Equipment & Machinery Co., St. Louis. Mr. Glauser will be located in St. Louis where he will assume management of the equipment department for the Southern territory.

ALBERT OLIVER, of Albert Oliver & Son, Inc., New York, manufacturers and distributors of fireproof building products, has completed a contract by which the Chicago Pneumatic Tool Co. will act as agent throughout the United States and Canada for the sale of the Oliver mortar gun. The device is to be demonstrated in the building of a new house on Pelham Parkway, New York, at an early date. This will be the first instance, according to Mr. Oliver, that the walls and partitions of a house will be erected with a mortar gun operated by compressed air. The method to be employed is designated as "New Departure Construction." Working with Mr. Oliver on the project are Edward I. Smith, Benjamin Smith, and Stanley Gollieck, the three men who erected the Clinton wire cloth fireproofing system for him on the first contract ever undertaken for that material — the Belvedere Hotel, Baltimore, Md. Associated with the men above named will be Roswell F. Easton, a specialist in fireproofing.

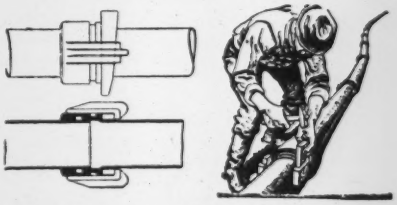
MILLS CO., Cleveland, Ohio, dealer in building equipment, has filed a certificate of statement and designation in the office of the Secretary of State, Albany, which will enable the company to do business in New York State, through its office already located at 7 E. 42d St., New York City.

GIBB INSTRUMENT CO., Bay City, Mich., manufacturer of electric welding and electric heating equipment, announces the appointment of H. V. Beronius as its representative in Iowa, Kansas, Nebraska, Oklahoma and northwestern Missouri. His headquarters will be 33 Linwood Terrace, Kansas City, Mo.

Equipment and Materials

A Quick-Coupling Pipe Joint

For conditions where pipe connections must be made with the utmost speed or where pipe is laid, taken up and relaid frequently, a new form of quick-coupling joint, known as the Phoenix, has been developed in Germany. As shown in the accompanying sketches, the joint is of the socket type and is



locked by a pair of wedges, one on each side. The pipe is usually of steel, seamless drawn, with the sockets welded on. These joints are being used on pipe up to 8 in. in diameter and for pressures up to 200 lb. per square inch. With smaller pipes, of about 2 in. in diameter, the coupling is said to have been effective under pressures of 700 lb. per square inch. The male and female elements of the joints are designed so as to allow the pipe to follow inequalities in the ground, making bends up to about 10 deg. The packing consists of hemp and inlaid rubber.

Tests are said to have shown that this form of pipe can be assembled in only a fraction of the time required for ordinary flanged couplings.

The joint is manufactured by the Rohrleitungsbau-Phoenix Co., Berlin-Mariendorf, Tempelhoferstr. 71-73, Germany, under patents granted to Erwin Braun of that company.

Dry Type Glue Pot With Rheostat for Heat Control

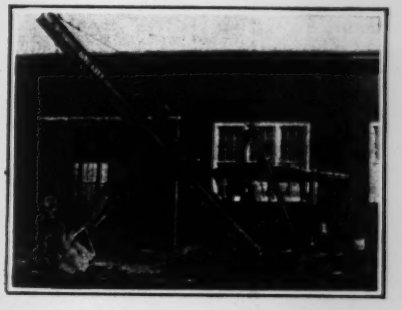
To retain those qualities that give it maximum adhesiveness glue should be carefully heated and handled. Changing climatic conditions and different grades of glue tend to vary the temperature to which glue must be heated. To meet the demand for a simple glue-pot having a wide range of heat control the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., has designed a pot with rheostatic control permitting almost unlimited variation in the wattage input and in the temperature.

The unit is a portable device as the rheostat can be laid on a bench or shelf or hung on a wall while a cord between the rheostat and the glue pot permits the glue pot being moved over a large radius. The convenience of having the glue pot at the best location saves trips to a central glue pot. The dry type glue pot used with this new unit has many advantages over the wet type. The inconvenience of refilling the water bath is eliminated; and danger of the pot boiling dry and burning out the heating element no longer worries the attendant.

The casing and bottom plate of the pot are made of heavy sheet steel and the glue vessel of heavy spun copper. The glue vessel may be removed and cleaned.

Changes in One-Man Excavator

Several changes involving lighter weight and sturdier construction have been made by the Bay City Dredge Works, Bay City, Mich., in the latest model of their one-man excavator, de-



signed to handle a ⅜-yd. power shovel bucket or a ½-yd. clamshell or dragline bucket. The more important new features of the excavator are: The use of a Hercules four-cylinder gasoline engine as the power unit; replacement of belt drive by direct gear and pinion drive connection to the motor; elimination of the swing drum, swing cable and A-frame crossbar by a worm-gear slewing arrangement at the bottom of the boom.

For better visibility by the operator the front mast has been removed. The size of the rear wheels has been increased and a square dipper handle has been substituted for the round dipper handle on former models. The front A-frame on the new machine is constructed of steel instead of wood; sheet metal instead of wood is used for the roof. Instead of being bolted, the new framework is riveted.

Publications from the Construction Industry

Snow Removal—HOLT MANUFACTURING CO., INC., Peoria, Ill., has issued a

10-p. illustrate pamphlet entitled "Keeping Winter Roads Open." The text illustrates the use of the company's caterpillar tractors equipped with various types of snow plow, with both straight and V-shaped blades.

Building Maintenance — TRUSCON LABORATORIES, Detroit, to help the man who has charge of the maintenance of buildings and equipment in large institutions, has prepared a wall chart or "maintenance map" showing in detail various maintenance requirements for basements, exteriors, interiors, floors, etc.

Automatic Scales—RICHARDSON SCALE Co., Passaic, N. J., is distributing a 32-p. illustrated bulletin describing its automatic scales for weighing crushed, lumpy, and granular material of specified test weight continuously in repeated equal loads. The number of discharges is mechanically registered. The text describes in detail the salient parts of the equipment including the apron feeding device, the weighing hopper and the discharge control. Photographs and blueprint reproductions show typical applications of the scales to a wide range of uses.

Sewer Cleaning Equipment.—TURBINE SEWER MACHINE Co., Milwaukee, describes its line of sewer cleaning equipment in a 64-p. illustrated booklet. The turbine sewer machine consists of a short shaft on which are mounted cutting knives revolved by water pressure. The line of equipment described includes windlasses, telescopic sewer braces, sewer rods, and pulley blocks. A number of photographs show roots and other obstructions removed by the sewer cleaning machine.

Construction Equipment—ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C., has prepared a report (cost 50c.) on current practices of accounting for construction equipment expenses after purchase. The text contains information on selection, maintenance and standardization of equipment, gives tables showing economical life and depreciation of commonly used equipment, including marine equipment, and illustrates form of lease, equipment service record and other forms.

Floor Operated Electric Hoist—SHEPARD ELECTRIC CRANE & HOIST Co., Montour Falls, N. Y., has just issued a comprehensive 59-p. illustrated booklet describing and illustrating the uses of each type of its floor-operated electric hoists. For lifting and load moving these machines have a wide use in industrial plants, warehouses, shops and stores. They are built to operate on both direct current and alternating current, are equipped with motors from 3½ to 20 hp., and have capacities from 1 to 12½ tons. The hoists are built in three standard types, without trolley (lug suspension), geared trolley and motor driven trolley. The line includes both variable speed and single speed models. Complete information for each type of hoist is given, including clearance dimensions, capacities, types of lifts, etc.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Summary of Total Construction in 1923 and 1924

The 1925 possibilities in the construction field can best be judged by a study of conditions in the last two years. The accompanying statement permits such a study. It is seen that 1924 (last five weeks estimated) is 8 per cent ahead of 1923, as regards money value of all work contracted for.

	Per Cent of Total	
	1923	1924
Housing	34	34
Other private construction	49	47
Public construction	17	19

The principal gains are in housing construction, roads and "unclassified" projects. Unclassified includes such jobs as bulkheads, piers, park improvements, grain elevators, stadiums, subways, etc.

Of construction exclusive of housing, public work averages 28 per cent, of which 65 to 70 per cent is road building.

When residential building and smaller structures in other types of building are omitted from the totals the weighting of public work becomes more impressive. *Engineering News-Record* aims to report all engineering-construction contracts awarded in the United States and Canada. These contracts reach the following minimums: waterworks and excavation, $15,000; other public works, $25,000; industrial construction, $40,000; commercial buildings, $150,000. Of this heavy construction, thus far in 1924, public contracts aggregate 49 per cent, private 51 per cent.

Construction contracts of the size stated in the foregoing paragraph, as reported to *Engineering News-Record*, totaled as follows in the last three years:

	Waterworks	Sewers	Bridges	Excav.	Sts. & Rds.	Buildings — Industrial	Buildings — Commercial	Fed. Gov't
1922	$36,220	$43,584	$43,477	$19,551	$334,694	$198,141	$750,762	$43,552
1923	62,518	66,769	66,778	51,991	361,837	281,611	813,392	47,940
1924	61,717	73,074	67,795	25,941	425,257	189,192	949,155	40,028

Taking 1923 construction as 100 in each class, the value for 1923 and 1924 would be as follows:

1922	58	66	65	39	93	70	93	92
1923	100	100	100	100	100	100	100	100
1924	99	109	102	50	117	67	117	83

This Year Heaviest On Record For All Classes Except Federal Government Work

	1923	1924
Housing (dwellings, hotels, apartments)	$1,984,000,000	$2,200,000,000
Other buildings	2,576,000,000	2,600,000,000
All buildings in U. S.	$4,560,000,000	$4,800,000,000
Water-works and sewers	260,000,000	270,000,000
Roads	724,000,000	850,000,000
Federal Government	96,000,000	80,000,000
Public buildings	32,000,000	40,000,000
All public construction	$1,112,000,000	$1,240,000,000
Bridges	$134,000,000	$136,000,000
Unclassified	292,000,000	400,000,000
All construction	$6,098,000,000	$6,576,000,000

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 297 to 310, are the following:

Apartment and store, New York, N. Y., for A. Brisbane, awarded to Todd, Robertson & Todd Corp., $2,000,000.

Factory, Boston, Mass., for Harbor Trust Co., awarded to F. T. Ley Co., $2,000,000.

Church and Office, Cleveland, O., for Euclid Ave. Baptist Church, awarded to De Vanet & Deitrick, $1,000,000.

Mercantile building, Boston, Mass., for W. M. Evatt, foundation awarded to C. R. Gow Co., $1,000,000.

Elevator addition, Argentine, Kan., for A. T. & S. F. R.R. Co., awarded to J. S. Metcalf Co., $1,000,000.

Business Briefs

Call money ranged from 3 to 3½ per cent, Dec. 1.

Time loans quiet, 60@90 days, 3½@3½; longer periods, 3½@3¾ per cent.

Commercial paper, best names, 3½ per cent; others, 3½, 4 to 6 months.

Foreign exchange (demand).

	Par	This Week	Last Week	Year Ago
Sterling	$4.86½	$4.63½	$4.62⅞	$4.33½
Franc	0.193	0.0544½	0.0528½	0.0535½
Lira	0.193	0.0435½	0.0433	0.0431½

Gains in Water-works, Sewers and Industrial Construction During November

Average Weekly Value of Contracts Let Below October But Heavier Than November of Last Year

The money value of contracts awarded on large engineering construction projects as published in the four issues of *Engineering News-Record* during November, amounted to $130,157,000.

This represents a weekly average of $32,539,250, against $39,277,400 during October, 1924, and $31,228,000 for November, 1923.

Minimum costs observed in the Construction News section of *Engineering News-Record* in each class of construction are as follows: Water-works and excavations, $15,000; other public works, $25,000; industrial construction, $40,000; and commercial buildings, $150,000.

Contracts let on water-works, sewers and industrial construction were heavier in November than during the month preceding. Recessions occurred in bridges, excavations, streets, roads, commercial buildings and Federal Government work.

Canadian construction dropped about 25 per cent, compared with October but was nearly double that of November, 1923.

Among the large contracts let during the month were the following: A 20 story apartment, New York, N. Y., $4,500,000; a 13 story apartment, Montreal, Que., $3,500,000; an office building, New York, N. Y., $3,000,000; 61-mi. of electric railway, Wisconsin So. Ry., $2,500,000; paving Minneapolis, Minn., $2,400,000; an oil storage tank, Big Lake, Tex., $2,000,000; a hotel, Detroit, Mich., $1,500,000.

Engineering News-Record Construction Cost Index Number

December, 1924	208.58
November, 1924	205.70
December, 1923	217.30
Peak, June, 1920	273.80
1913	100.00

Jan., 1923	191.70	Dec.	217.30
Feb.	197.40	Jan., 1924	217.90
Mar.	205.25	Feb.	220.30
April	213.50	Mar.	224.60
May	216.70	Apr.	221.60
June	220.70	May	222.38
July	222.10	June	216.85
Aug.	221.50	July	214.40
Sept.	221.50	Aug.	213.15
Oct.	220.30	Sept.	211.25
Nov.	220.90	Oct.	207.55

Engineering News-Record's Construction Cost Index Number advanced 2.88 points since last month, owing to higher costs of steel and common labor. The average rate for common labor is now 56¼c. per hr., against 56c. one month ago and 54c. in December, 1923. Thus general construction cost is 4 per cent lower than one year ago and 24 per cent under the peak; it is 109 per cent above the 1913 level.

Engineering News-Record Construction Volume Index Number

November, 1924 *(4 issues of E. N.-R.)*	108
October, 1924 *(5 issues of E. N.-R.)*	174
November, 1923 *(5 issues of E. N.-R.)*	125

Entire Year

1923	135
1922	130
1921	88
1920	91
1919	91
1918	80
1917	64
1916	97
1915	95
1914	104
1913	100

Engineering News-Record's Construction Volume Index Number is 108 for the month of November, and 135 for the whole of 1923, as against 100 for 1913. This means that the actual volume of construction in 1923 (not the mere money-value of the contracts let that year) is 35 per cent above the volume of construction for 1913. Our monthly volume number, 108 for November, 1924, contains the increment of construction and indicates the rate at which contracts are being let as compared with 1913 awards.

VALUE OF CONTRACTS LET IN THE UNITED STATES AND CANADA DURING NOVEMBER, 1924

	New England	Middle Atlantic	South	Middle West	West of Mississippi	Far West	United States	Canada	Grand Total
Water-works	.....	$770,000	$212,000	$884,000	$1,925,000	$97,000	$3,888,000	$109,000	$3,997,000
Sewers	.....	1,322,000	38,000	1,639,000	1,955,000	1,805,000	6,757,000	105,000	6,862,000
Bridges	$238,000	.....	606,000	213,000	1,040,000	212,000	2,309,000	80,000	2,389,000
Excavation, drainage and irrigation	25,000	.....	242,000	98,000	11,000	540,000	916,000	37,000	943,000
Streets and roads	95,000	1,457,000	5,140,000	2,075,000	7,293,000	1,448,000	17,508,000	874,000	18,382,000
Industrial buildings	840,000	2,161,000	60,000	2,730,000	3,635,000	1,090,000	10,516,000	40,000	10,556,000
Commercial buildings	8,902,000	18,961,000	5,033,000	7,445,000	8,019,000	7,287,000	55,647,000	4,000,000	59,647,000
Federal Government	603,000	735,000	551,000	68,000	487,000	325,000	2,769,000	.....	2,769,000
Unclassified	98,000	10,609,000	109,000	8,785,000	3,230,000	853,000	23,684,000	928,000	24,612,000
November, 1924	$10,801,000	$36,015,000	$11,991,000	$23,937,000	$27,595,000	$13,655,000	$123,994,000	$6,163,000	$130,157,000
October, 1924	$12,914,000	$74,918,000	$14,684,000	$32,764,000	$32,510,000	$28,597,000	$196,387,000	$10,000,000	$206,387,000
November, 1923	$4,230,000	$38,905,000	$18,970,000	$32,831,000	$34,839,000	$22,169,000	$151,944,000	$4,196,000	$156,140,000

Labor Rates and Conditions Throughout the Country

There are twelve favorable and important factors in the present commercial and industrial situation that far outweigh the rise in the cost of living (less than one per cent in three months) and other adverse elements.

Briefly the twelve may be outlined as follows: (1) Construction to date is between 4 and 6 per cent ahead of the corresponding period in the record year 1923. (2) Heaviest weekly car loadings on record are being made by railroads of the country. (3) Stock market activity greatest in five years. (4) Bank debits gradually gaining in volume. (5) Increased steel output and demand. (6) Improvement in the textile situation; prices higher. (7) Gain in employment in the manufacturing industries. (8) Higher per capita earnings than during the summer. (9) Easy credit conditions. (10) Betterment of the agricultural situation; rise in prices of farm products. (11) Greater activity in the chemical industries; prices advancing. (12) More optimistic outlook in the paper industry.

Building trades wage schedules show little disposition to recede from present levels. In fact, the average common labor rate for the nation is ¼c. per hr. above the November level.

Unskilled laborers (pick and shovel men) in the construction industry, receive an average wage of 56¼ per hr. at the present time, against 56c. for the past seven months and 54c. per hr. in December, 1923.

Local conditions as reported to *Engineering News-Record*, follow:

Baltimore—Conditions continue normal in the construction industry.

Birmingham—Common laborers in good demand but sufficient to meet all present requirements. Non-union men not much in evidence. Building conditions best ever known. Brisk demand for concrete workers and brick layers.

Boston—All trades plentiful; common laborers especially so.

Detroit—Labor rates in construction industry remain unchanged. No shortages in any of the trades.

Dallas—Small surplus of skilled mechanics. Men are returning from the cotton fields and the common labor shortage is consequently less acute.

Kansas City—Plenty of skilled men. Bonuses still granted to bricklayers.

Los Angeles—Labor market over supplied. Construction, however, is still active.

Montreal—Surplus of common labor.

CURRENT BUILDING TRADES WAGE RATES PER HOUR

(Higher rates indicated by +, decreases by —)

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$1.12½	$0.70	$0.70	$0.50	.....	$0.75	$0.25@.30
Baltimore	1.75	.90@1.20	1.00@1.12½	1.00	$0.65	1.12½	.40
Birmingham	1.00@1.50	.25@.75	+.75@1.25	+.35@.50	.....	.75@1.25	.25@.40
Boston	1.25	1.00@1.10	1.25@1.35	+.87½	1.05	1.25	.50@.75
Cincinnati	1.50	1.25	1.25	.92½	1.25	1.25	.55
Chicago	1.50	1.15@1.25	1.10@1.25	1.00	1.25	1.25	.75@.82½
Cleveland	1.50	1.25	1.25	.87½	1.00	1.37½	.87½
Dallas	1.50	1.00	1.00	.40@.75	.87½	1.00	.40@.75
Denver	1.62½	1.12½	1.12½@1.18¾	.81¼@.87½	1.00	1.15⅝	.35@.55
Detroit	1.50	.90@1.00	.85@1.00	.90	.85@1.00	1.12½	.60@.75
Kansas City	1.50	—1.00@1.25	1.00@1.25	.87½	—1.00@1.12½	—1.00@1.12½ +	.50@.75
Los Angeles	1.25	.87½	.87½	1.12½	.75	.87½	.50
Minneapolis	1.12½	.87½	.87½	.71½	.....	.87½	.50@.55
Montreal	1.00	.65	.62½	.45	.50	.65	.25@.30
New Orleans	1.25	.90	1.00	.65	.80	1.00	.35@.40
New York	1.50	1.31¼	1.50	1.00	1.00@1.12½	1.31¼	.62½@.75
Philadelphia	1.50	1.12½	1.02¼	1.12½	1.00	1.12½	.40@.45
Pittsburgh	1.55	1.37½	+1.37½@1.25	1.00	.....	1.37½	.70
St. Louis	1.75	1.50	1.50@1.67½	1.15@1.25	1.25	1.50	.45@1.10
San Francisco	1.25	1.00	1.00	.81¼	1.00	1.12½	.50@.55
Seattle	1.25	1.00	1.00@1.12½	1.00	1.00@1.12½	1.12½	.62½

New Orleans—Sufficient number of building trades mechanics to meet all demands.

New York—Despite the slight decrease in building activities, due to the completion of several large projects, the amount of work scheduled for winter operations will prevent any unemployment of local building trades mechanics between now and spring.

Pittsburgh — Enough men in all trades for present requirements.

San Francisco—All building trades actively employed. Some very large building projects already under way. Residential construction particularly active.

Seattle—Building going on at record pace in Seattle and Puget Sound cities. Some general unemployment but conditions not serious.

Monthly Prices of Construction Materials

Ups and Downs of the Market

Price advances predominate in the current market. A month ago the trend was downward. Iron, steel, scrap, lumber, railway supplies, road and paving materials are all on the up grade. Some weakness still prevails in c.-i. pipe, lime, clay products and linseed oil.

Pig Iron—Present strong upward trend of prices due to continuation of buying movement. No. 2 fdry., Southern, now $19@$20, against $18@$18.50, a month ago and $22 per ton in December, 1923. Inquiries are active, with slight pressure for deliveries.

Railway Supplies—Railroad buying of car materials active. Light rails and standard spikes up $2 per ton at Pittsburgh during month. Re-rolled rails also higher.

Pipe—Present decline in cast-iron pipe purely seasonal, as buying usually slows down at this time of the year. Sewer pipe and clay drain tile lower in Pittsburgh, St. Louis, Birmingham, Detroit and several other cities throughout the country.

Road and Paving Materials—The definite upward turn in road oils and asphalt prices in New York, Boston Kansas City and other points is evidently due to the Mexican situation. Granite paving blocks have advanced 50c. per M. in Boston; 15c. per sq.yd. in Kansas City and 10c. to 25c. per sq.yd. in Philadelphia, since last month. There is also a strong upward trend in wood blocks. St. Louis and Atlanta both report advances. While quotations in New York are no higher than a month ago, the increasing costs of lumber and oil are exerting an upward influence upon the market.

Sand, Gravel and Crushed Stone—Price fluctuations are almost absent from the market so far as these three materials are concerned. No changes in the price of sand occurred during the past sixty days in twenty large cities reporting regularly to *Engineering News-Record.*

Lime and Cement—For every advance in lime prices reported during the month there were two declines. The principal advances occurred in Minneapolis and Kansas City; the declines, in Boston and Detroit. Cement remains firm at present levels.

Brick and Hollow Tile—Brick, tile and other clay products have shown considerable price weakness during the month. Production has been heavy but with an active winter building program ahead, followed by the usual spring demand, an upward turn is looked for during the first quarter of 1925. Declines in brick prices occurred in St. Louis, Boston, Kansas City, New Orleans and Cleveland. Hollow tile dropped in Boston, Kansas City, Detroit, Cleveland and St. Louis.

Structural Steel—Fabricated structurals form the bulk of current demand. Increased demand, however, is being met by a commensurate gain in ingot production. Reinforcing bars have advanced 10c. during the past week; shapes and plates, 5c. per 100 lb. at mills. The present level is about 7c. per 100 lb. above a month ago. Bars are now $2.10; shapes, $1.85@$2.10; and plates, $1.80@$2 per 100 lb., Pittsburgh.

Lumber—Demand is slightly in excess of production according to latest reports from mills. Output and orders are both on the increase. There is little buying for replenishment of yard and factory stocks. Better grades of yellow pine flooring are in good demand. Price advances are more numerous than declines in the current market. Pine rose in New Orleans, Minneapolis, Kansas City and Philadelphia and declined in New York, Boston and St. Louis during the month. Fir advanced in Minneapolis and Denver and dropped in Boston and Philadelphia during the same period. Spruce and hemlock are easier in the East while the latter is developing firmness in the West.

Linseed Oil—Raw oil is $1.11 per gal. (5 bbl. lots) f.o.b. New York, against $1.14, one week ago and $1.08, one month ago. Last year at this time the price was 95c. per gal. There has been no reaction from the recent upward trend in Dallas and Atlanta.

Iron and Steel Scrap—Heavy melting steel is up $1.50 per ton in New York; other descriptions have advanced $1 per ton since last month.

Prices advance since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Per Gross Ton f.o.b.:

	Dec. 4	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25@2.75)	**$22.55**	$25.05
Northern Basic	**21.77**	24.00
Southern Ohio No. 2 (silicon 1.75@2.25)	**22.27**	24.00
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25@2.75)	25.10	28.00
BIRMINGHAM		
No. 2 Foundry (silicon 2.25@2.75)	**19@20**	22.00
PHILADELPHIA		
Eastern Pa., No. 2X (2.25@2.75 sil.)	**22.50**	24.25
Virginia No. 2 (silicon 2.25@2.75)	29.75	28.17
Basic	**21.75**	24.00
Gray Forge	**21.75**	24.00
CHICAGO		
No. 2 Foundry Local (silicon 1.75@2.25)	20.50	24.50
No. 2 Foundry Southern (silicon 2.25@2.75)	**25.00**	27.00
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley (silicon 1.75@2.25)	22.77	25.77
Basic	22.77	25.77
Bessemer	23.77	26.77

SCRAP—The prices following are f.o.b., per gross ton paid to dealers and producers:

	New York	Chicago	Birmingham
No. 1 railroad wrought	$14.00	**$16@16.50***	12.00@13.00
Stove plate	**11.00**	**15.50@16***	*13.00@14.00*
No. 1 machinery cast	14.00	**18@18.50***	14.00@15.00
Machine shop turnings	**9.00**	**11@11.50**	6.00@7.00 *
Cast borings	**10.00**	**13@13.50**	**15.00@16.00**
Railroad malleable	13.00	**19.50@20**	**18.00**
Re-rolling rails	**15.00**	**18.50@19**	**17.00**
Re-laying rails	22.00	26@27	**26.00**
Heavy melting steel	**13.50**	**17.50@18**	18.00

*Per net ton.

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh Dec. 4	Pittsburgh One Year Ago	Birmingham	Chicago	St. Louis
Standard bessemer rails	$43.00	$43.00	$43.00	$43.00	
Standard openhearth rails	43.00	43.00	43.00	43.00	**$50@52**
Light rails, 8 to 10 lb.	**36@37**	45.00	2.00*1.80@1.90*		
Light rails, 12 to 14 lb.	**36@37**	45.00	2.00*1.80@1.90*	*2.05@2.15*	
Light rails, 25 to 45 lb.	**36@37**	45.00	2.00*1.80@1.90*	*1.95@2.10*	
Re-rolled rails	**30@34**	37@40			*19@20*

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8½ Ft.	7 In. x 9 In. by 8½ Ft.
Chicago, White Oak	$1.45	$1.70
Chicago, (creosoted) (zinc treated)	1.85	2.10
San Francisco, Green Douglas Fir	.84	1.14
San Francisco, Empty Cell Creosoted, Douglas Fir	1.70	2.25
St. Louis, White Oak, plain	1.20	1.40
St. Louis (creosoted) (zinc treated)	1.60	1.90
St. Louis, Red Oak, plain	1.10	1.30
St. Louis, Sap pine-cypress	.95	1.15
Birmingham, White Oak	1.25	*1.45*

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named

	Pittsburgh Dec. 4	Pittsburgh One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, ⅝-in. and larger	$2.80	$3.15	*$2.96*	$3.75	$4.35	*$2.80*
Track bolts	3.75@4.00	4.00	*3.90*	4.65	5.85	*4.00*
Standard section angle bars	2.75	2.75	*2.75*	3.40	4.00	*2.85*

*Mill.

PIPE

WROUGHT PIPE—The following discounts are to jobbers for carload lots at Pittsburgh mill:

BUTT WELD

Inches	Steel Black	Steel Galv.	Inches	Iron Black	Iron Galv.
1 to 3	62	50½	1 to 1½	30	13

LAP WELD

2	55	43½	2	23	7
2½ to 6	59	47½	2½	26	11
7 and 8	56	43½	3 to 6	28	13
9 and 10	54	41½	7 to 12	26	11
11 and 12	53	40½			

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1½	60	49½	1 to 1½	30	14
2 to 3	61	50½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	53	42½	2	23	9
2½ to 4	57	46½	2½ to 4	29	15
4½ to 6	56	45½	4½ to 6	28	14
7 and 8	52	39½	7 and 8	21	7
9 and 10	45	32½	9 to 12	16	2
11 and 12	44	31½			

WROUGHT PIPE—From warehouses at the places named the following discounts hold for steel pipe:

	Black New York	Black Chicago	Black Birmingham	Black St. Louis
1 to 3 in. butt welded	48%	56%	*62%*	49%
2½ to 6 in. lap welded	44%	53%	*59%*	46%

	Galvanized New York	Galvanized Chicago	Galvanized Birmingham	Galvanized St. Louis
1 to 3 in. butt welded	34%	43%	*50½%*	36%
2½ to 6 in. lap welded	30%	40%	*47%*	33%

Malleable fittings, Classes B and C, banded, from New York stock sell at list plus 4%; class A, plus 23%. Cast iron, standard sizes, 36% off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	Birmingham	Pittsburgh	New York Dec. 4	New York One Year Ago
4 in.	*$44.00*	*$60.50@61.60*	*$60.60@61.60*	$67.10@68.60
6 in. and over	*40.00*	*55.50@56.60*	*55.60@56.60*	62.10@63.60

	Chicago	St. Louis	San Francisco
4 in.	*$51.20@52.20*	*$52.60*	*$59.00*
6 in. and over	*47.20@48.20*	*48.60*	*55.00*

Gas pipe and Class "A," $4 per ton extra.

CLAY DRAIN TILE—The following prices are per 1,000 lin.ft.:

Size, In.	New York Dec. 4	New York One Year Ago	St. Louis	Birmingham	San Francisco	Dallas
3	$45.00	$45.00	*$40.00*	$45.00	....	$73.00
4	55.00	55.00	*40.00*	56.00	$76.50	110.00
5	80.00	80.00	....	80.00	97.75	118.00
6	105.00	105.00	*70.00*	104.00	127.50	150.00
8	170.00	170.00	*170.00*	170.00	212.50	210.00

SEWER PIPE—The following prices are in cents per foot for standard pipe in car load lots, f.o.b., except as otherwise stated:

Size, In.	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	....	*$0.09*	*$0.10*	....	....	$0.12	....
4	....	.09	.10	*$0.10*	....	.15	$0.15
5	....	*.135*	**.149**	....	....	.18	.18
6	$0.21	*.135*	*.149*	*.14*	....	.21	.21
8	.36	*.21*	*.232*	*.225*	....	.30	.325
10	.53	*.315*	*.347*	*.315*	....	.42	.475
12	.68	*.405*	*.446*	*.405†*	....	.54	.612
15	1.14†	*.54*	*.60*	*.675†*	....	.90	1.02
18	1.65†	*.75*	**.825**	*.945†*	....	1.32	1.53
20	2.00†	*.90*	*.99*	*1.26†*	....	....	....
22	2.65†	*1.20*	*1.40*	....	....	....	1.564
24	2.97†	*1.35*	*1.50*	*1.62†*	....	2.16	2.04
27	4.65†	2.665	*2.70*	*2.45†*	....	3.00	3.34
30	5.16†	2.952	3.00	*3.00†*	....	3.60	4.06
33	6.98†	3.96	4.00	*3.55†*	....	....	4.99
36	8.00†	4.51	4.60	*3.95†*	....	....	5.42

	3	5	8	12	24	36
Boston	*$0.13*	$0.215	**$0.375**	**$0.75**	**$2.38†**	**$6.55†**
Minneapolis	....	.09	.40	.72	2.55†	5.66†
Denver	.135*	.18*	.27	.47	1.70	....
Seattle	.14	....	.35	.72†	2.60†	....
Los Angeles	.1625	.195	.275	.495	1.65	....
New Orleans	.148*	.207*	.345	.586	1.182	....
Cincinnati	.105	.1575	.245	.4725	1.575	4.715
Atlanta	.11*	.135	.225	.3825	1.4625	....
Montreal	.68‡	.45†	.70	1.35	4.50†	....
Detroit	*.093*	*.1395*	*.217*	*.4185*	*2.115†*	*5.535†*
Baltimore	.111	*.166*	.259	.499	1.665	4.92
Kansas City, Mo.	**.15***	*.21**	*.335*	.52†	2.09†	4.00†
Philadelphia	.12	.18	.28	.54	1.80	4.61

*4-in., 6-in., 9-in., respectively. †Double Strength. ‡3-in. special.

ROAD AND PAVING MATERIALS

ROAD OILS—Following are prices per gallon in tank cars 8,000 gal. minimum f.o.b. place named:

		Dec. 4	One Year Ago
New York, 45% asphalt	(at terminal)	**$0.07**	$0.055
New York, 65% asphalt	(at terminal)	**.0725**	.052
New York, binder	(at terminal)	**.075**	.06
New York, flux	(at terminal)	**.075**	.05
New York, liquid asphalt	(at terminal)	**.075**	.048
St. Louis, 40@50% asphalt		.0475	.053
St. Louis, 50@60% asphalt		.0481	.055
Birmingham, 45% asphalt		.0495	....
Birmingham, 55% asphalt		.0455	....
Dallas, 45% asphalt		.0495	.0495
Dallas, 55% asphalt		.0455	.0455
Dallas, binder		.061	.061
San Francisco, binder, per ton		11.00*	9.50*

* F.o.b. Oelum, Cal. Freight to San Francisco, 80c. per ton.

ASPHALT—Price per ton in packages (350-lb. bbls. or 425-lb. drums) and in bulk in carload lots, f.o.b. points listed:

	Package	Bulk
New York (*Mexican*)	$23.00*	$18.00
Boston (*Mexican*)	21.00	16.50
Chicago (*Stanolind*)	21.00	15.00
San Francisco, *f.o.b. refinery*, Oleum, Cal.	17.00	11.00
Dallas (*Texas*)	27.10	21.10
Seattle, "*D*" *grade, California, f.o.b. Richmond*	22.25	20.50
Denver (*California*)	24.00	
Minneapolis, *f.o.b. Twin Cities* (*Stanolind*)	25.10	19.10
St. Louis (*Mexican*)	28.50	23.50
Baltimore (*Mexican*)	18.00	14.00
Montreal (*Imperial*)	28.00	21.00
Atlanta (*Mexican*)	32.00	28.50
Detroit (*Mexican*)	22.00	18.00
Cincinnati (*Kentucky Rock*)		11.65
Maurer, N. J. (*Bermudez*)	28.00	26.00
Maurer, N. J. (*Mexican*)	20.50	17.50
Philadelphia (*Mexican*)	*17.00*	*13.00*
Kansas City (*Texas*)	27.30	25.30
Los Angeles ("*D*" *grade, California*)	18.00	12.00†
Birmingham (*Mexican*)	32.00	28.50
New Orleans (*Mexican*)	23.00	17.00

*In drums. †f.o.b. El Segundo Refinery.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums; 200 to 300 gal. to the ton.

PAVING STONE—

New York (grade 1)	5-in. granite, 30 blocks per sq.yd.	$135.00 per M.
Chicago	About 4x8x4 dressed	per sq.yd.
	About 4x8x4 common	per sq.yd.
San Francisco	Basalt block 4x7x8	70.00 per M.
Boston	5-in. granite, 28 blocks per sq.yd	132.50 per M.
Atlanta	Granite	2.50 per sq.yd.
Detroit	5-in. Granite	3.00 per sq.yd.
Baltimore	Granite	2.85 per sq.yd.
Montreal	Granite	104.75 per M.
New Orleans	Granite, 4x8x4	3.25 per sq.yd.
Cincinnati	Granite	135.00 per M.
St. Louis	4x8x4	1.65 per sq.yd.
Kansas City	Granite	4.00 per sq.yd.
Philadelphia	Granite	3.25@4.25 per sq.yd.
Minneapolis	Sandstone	2.74 per sq.yd.

FLAGGING—

New York	Bronx, 4 ft. wide	$0.22 per sq.ft.
	Manhattan, 4 ft. wide	.22 per sq.ft.
	Queens, 5 ft. wide	.24 per sq.ft.
	6x24-in. cross-walk	1.20 per lin.ft.
Chicago	18 in. wide	per lin.ft.

CURBING—*New York:* Bluestone per lin.ft., f.o.b. barge New York, 5x16 in., 85c.; 5x20 in., Queens, 95c. *St. Louis:* Class "A" straight, delivered, 5x16 in., 90c. per lin.ft.

WOOD BLOCK PAVING—

	Size of Block	Treatment	Per Sq.Yd
New York (*delivered*)	3	16	$2.39
New York (*delivered*)	3½	16	2.67
Boston	3½	18	2.60
Chicago	4	16	
Chicago	3½	16	
St. Louis	3½	16	2.40
St. Louis	4	16	2.70
Seattle	4	16	Off market
Minneapolis	3½	16	2.75
Atlanta	3½	16	2.00
New Orleans	3	16	1.70
New Orleans	3½	16	2.10
New Orleans	4	16	2.50
Dallas	4	18	3.90
Baltimore	3½	16	None used
Montreal	4	16	4.50
Detroit	3	16	1.94
Detroit	4	16	
Cincinnati	3½	16	2.38
Kansas City	4	16	*3.95*
Philadelphia	4	16	None used

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for cargo or carload lots to contractor is as follows, per cu.yd.:

	Gravel 1½ In.		Gravel ¾ In.		Sand	
	Dec. 4	One Year Ago	Dec. 4	One Year Ago	Dec. 4	One Year Ago
New York (*alongside dock*)	$2.00	$2.00	$2.00	$2.00	$1.00	$1.25
Denver	1.90	1.90	1.90	1.90	1.00	1.00
Chicago		2.00		2.00		2.00
St. Louis	1.45†	2.30†	1.45†	2.35†	1.18†	2.10†
Seattle	1.50	1.25	1.50	1.25	1.50	1.25
Dallas	2.38	2.38	2.38	2.38	2.00	2.00
Minneapolis	1.65*	1.85*	1.65*	1.85*	1.25	1.25
Cincinnati	1.40†	1.35†	1.40†	1.35†	1.35†	1.30†
San Francisco	2.15	2.15	2.15	2.15	1.50	1.50
Boston	1.50†	1.40†	1.50†	1.40†	1.00†	1.10†
New Orleans	3.00	2.85	3.00	2.85	1.25	1.25
Los Angeles	1.50*	2.50†	1.55†	2.50†	1.10†	1.75†
Atlanta	1.90†	1.75†	1.90†	1.75†	1.40†	1.20†
Detroit	2.02	1.62	2.02	1.62	1.62	2.02‡
Baltimore	1.40	1.40	1.60	1.60	0.70†	0.70†
Montreal	1.25†	1.25†	1.50†	1.50†	1.25†	1.25†
Birmingham	2.00		2.00		1.30†	1.30†
Philadelphia	2.10	2.00	2.10	2.00	1.50	1.50
Kansas City	4.00‡		4.00‡		0.66*	0.66*†

New York—Grits, $1.75 per cu. yd.; ready mixed, $2.00.
Los Angeles—Freight from quarry, 70c. per ton, and is included in above price.
* At pit. † Per ton.

CRUSHED STONE—Price for cargo or carload lots f.o.b. city, unless stated otherwise, is as follows, per cu.yd.:

	1½ In.			
	Dec. 4	One Year Ago	Dec. 4	One Year Ago
New York	$1.75	$1.65	$1.85	$1.75
Chicago		2.00		2.00
St. Louis	1.75*	1.70*	1.75*	1.90*
Dallas	2.40	2.83	2.83	2.83
San Francisco	2.15	2.15	2.15	2.15
Boston	1.60*	1.55*	1.60*	1.55*
Minneapolis	1.75	1.85	1.75	2.00
Kansas City	1.50	1.50	1.50	1.50
Denver	*2.50*	3.50	*2.50*	3.50
Seattle	3.00	3.00	3.00	3.00
Atlanta	2.00*	1.90*	2.00*	1.90*
Cincinnati	1.90*	1.65*	1.90*	1.65*
Los Angeles (*at quarr.*)	1.65*		1.75*	
Detroit	1.70	1.75	1.70	1.75
Baltimore	2.50	2.50	2.55	2.55
Montreal	1.80*	1.80*	2.25*	1.90*
Philadelphia	2.10	2.00*	2.10	2.00*
Pittsburgh	2.85	2.85	2.85	2.85
Cleveland	3.25*	3.25*	3.25*	3.25*
Birmingham	1.00		1.20	

*Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, f.o.b. cars, per net ton, at plants:

	1½-In.	¾-In.	Roofing	Sand
Youngstown District	*$1.25*	*$1.35*	$2.00	*$1.25*
Steubenville District	*1.25*	*1.30*	2.00	*1.30*
Ironton District	1.40	1.40	2.00	1.40
Easton, Catasauqua, Pa.			2.50	
Birmingham, Ala.	1.00	1.20		
Buffalo, N. Y., and Erie, Pa.	1.25	1.25	2.25	1.25
Cleveland, Ohio	*1.30*	*1.30*	*1.30*	1.30
Eastern Pa. and Northern N. J.	1.25	1.25	2.50	1.25
Western Pennsylvania	1.25	1.25	2.50	1.25
Longdale and Glen Wilton, Va.	1.25	1.25	2.50	
Toledo, Ohio	*1.25*	*1.25*	1.50	*1.25*

LIME—Warehouse prices:

	Hydrated, per Ton		Lump, per Barrel	
	Finishing	Common	Finishing	Common
New York	$18.20	$12.00@$13.10	$3.75*	$2.50@3.00*
Chicago				
St. Louis	24.00	20.00		18.75‡
Boston	*20.00*	*15.00*	*3.90**	*3.15**
Dallas	20.00			1.85†
Cincinnati	16.80	14.30		13.40‡
San Francisco	22.00	16.00		1.60†
Minneapolis	23.00	21.00 (white)	1.60†	1.35†
Denver	24.00			2.70†
Detroit	*16.00*			*17.00‡*
Seattle, *paper sacks*	24.00		2.80†	
Los Angeles			18.00‡	2.70†
Baltimore	24.25		2.55†	
Montreal		21.00		10.50‡
Atlanta	22.50	14.00	2.40†	1.45†
New Orleans	24.00	18.00	2.20†	2.20†
Philadelphia	23.00	16.00		
Kansas City	19.50		17.50‡	15.00‡
Birmingham	19.00	14.00	2.00†	*1.50†*

*Per 280-lb. bbl. (net). †Per 180-lb. bbl. (net). ‡Per ton—Refund of 10c. per bbl. Minneapolis quotes brown common lump lime; Kelly Is. white is $1.80, Sheboygan $1.70. New York quotes hydrated lime "on cars" in paper sacks, lump lime "alongside dealer's dock" or "on cars."

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, f.o.b. exclusive of bags:

	Dec. 4	One Year Ago
Minneapolis (Rosendale)	$2.80	$2.80
Kansas City (Ft. Scott)	1.50	1.50
Cincinnati (Utica)	1.72	1.72
Boston (Rosendale)	2.50	2.80
St. Louis (Carney)	2.35	2.25
Birmingham (Magnolia) pozzolan cement	2.25	2.10

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b. points listed *without bags*. Cash discount not deducted.

	Dec. 4	One Month Ago	One Year Ago
New York, del. by truck	$2.50@2.60	$2.50@2.60	$2.55@2.65
New York, alongside dock to dealers	2.15	2.15	2.15
Jersey City	2.33	2.33	2.33
Boston	*2.67½*	2.70	2.92
Chicago	2.20	2.20	2.10
Pittsburgh	2.19	2.19	2.19
Cleveland	2.39	2.39	2.41
Detroit	2.40	2.40	2.37
Indianapolis	2.41	2.41	2.31
Milwaukee	2.35	2.35	2.25
Duluth	2.19	2.19	2.19
Peoria	2.37	2.37	2.27
Cedar Rapids	2.44	2.44	2.38
Davenport	2.39	2.39	2.29
St. Louis	2.30	2.30	2.35
San Francisco	2.61	2.61	2.61
New Orleans	2.80	2.80	2.80
Minneapolis	2.42	2.42	2.42
Denver	2.84	2.84	2.84
Seattle	2.65	2.65	2.90
Dallas	2.05	2.05	2.05
Atlanta	2.35	2.35	2.35
Cincinnati	2.47	2.47	2.41
Los Angeles	2.60	2.60	3.16
Baltimore	2.90	2.90	2.61
Birmingham	2.40	2.40	2.80
Kasas City	*2.07*	2.42	2.27
Montreal	1.80	1.80	2.25
Philadelphia	2.41	2.41	2.81
St. Paul	2.42	2.42	2.42
Toledo	2.45	2.45	2.38

NOTE—Bags 10c. each, 40c. per bbl.; 20c. each in Canada, 80c. per bbl.

Current mill-prices per barrel in carload lots, without bags, to contractors:

Buffington, Ind	$1.95	Hudson, N. Y.	$2.05
Universal, Pa	1.95	Leeds, Ala	1.95
Steelton, Minn	2.00	Hannibal, Mo	2.05
Fordwick, Va	2.05	Lehigh Valley District	1.95
Mitchell, Ind	2.05	Wyandotte, Mich	2.15
Iola, Kan	1.95	Alpena, Mich	2.00
Mason City, Ia	2.00	Richard City, Tenn	2.05
La Salle, Ill	2.05	Kingsport, Tenn	2.05

TRIANGLE MESH—Price per 100 sq.ft. in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh Mill	Birmingham Mill	Warehouse: New York	Warehouse: St. Louis	Warehouse: Dallas	Warehouse: San Francisco
032	22	$0.95	$0.95	$1.39	$1.04	$1.13	$1.15
049	28	1.20	1.20	1.76	1.32	1.38	1.45
068	35	1.47	1.47	2.16	1.62	1.67	1.78
093	45	1.89	1.90	2.77	2.08	2.00	2.78
126	57	2.34	2.35	3.45	2.59	2.55	2.85
153	68	2.79	2.80	4.11	3.08	3.15	...
180	78	3.20	3.25	5.70	3.54	3.47	...
243	103	4.22	4.25	6.21	4.66	4.58	...
287	119	4.88	4.90	7.19	5.39	5.26	5.94
336	138	5.66	5.70	8.35	6.25	6.11	...
395	160	6.56	6.60	9.65	7.25	7.12	...
		PAVING					
036P	17	$0.72	$0.72	$1.06	$0.79	$0.76	...
053P	24	1.02	1.02	1.50	1.12	1.07	...
072P	31	1.29	1.29	1.90	1.42	1.39	...
097P	40	1.66	...	2.45	1.83	1.90	...
049R	24	...	1.66	...	1.12	1.07	...
067R	31	...	...	...	1.42	1.39	...
089R	40	...	...	...	1.83	1.90	...

In rolls, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft. lengths. Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in. wide x 150 ft. long, or 600 sq.ft.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted are as follows:

Weight in pounds	New York	Birmingham	St. Louis	San Francisco	Dallas
2.2	$21.00	$21.00	*$19.00*	$24.00	$23.50
2.5	23.00	22.00	21.00	26.00	25.00
3.0	27.00	25.00	24.50	30.00	28.50
3.4	29.00	27.00	26.50	...	31.00

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Inches	Pittsburgh Mill	Warehouse, Uncut: Birmingham	New York	Chicago	St. Louis	Dallas	San Francisco
¼ and larger	**$2.10**	$2.00	$3.24	$3.00	$3.15	$3.38	$3.35
⅜	**2.15**	2.05	3.34	3.10	3.25	3.43	3.45
½	**2.20**	2.10	3.44	3.20	*3.35*	3.48	3.55
⅝	**2.30**	2.25	3.64	3.40	*3.55*	3.63	3.75
¾	**2.60**	2.55	4.24	4.00	*4.15*	3.78	4.35

For size and cutting extras, manufacturers and distributors, see bar card of July 1, 1923.

ROLLED FROM RAILS

	Birmingham	St. Louis	Dallas		Birmingham	St. Louis	Dallas
¼ and larger	$3.00	$3.00	$3.08	¾	...	$3.20	$3.30
⅜ in.	3.05	3.05	3.13	½	...	3.50	3.48
½	3.10	3.10	3.18	...	...	...	...

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common: Dec. 4	Common: One Month Ago	Common: One Year Ago	Paving Block: 3-inch*	Paving Block: 4-inch*
New York (del.)	$18.00	$18.00	$22.55	$44.00†	$51.00†
New York (at dock)	15.00	15.00	19.00	...	...
Chicago	...	...	11.00	50.00	50.00
St. Louis, salmon	*14*@16	16@18	16@18	38@40	40@42.50
Denver, salmon	12.00	12.00	12.00	...	...
Dallas	12.10	12.10	11.60	35.00	...
San Francisco	15.50	15.50	15.50	...	...
Los Angeles	15.00	15.00	14.50	(not used)	
Boston (del.)	*21.00*	21.50	22.00	*47.00*	55.00
Minneapolis (del.)	**15.00**	14.00	16@18	...	...
Kansas City	*14.50*	16.50	16.50	(no market)	
Seattle	15.00	15.00	15.00	...	42.50
Cincinnati	17.00	17.00	18@19	40.00	45.00
Montreal	17.50	17.50	16.50	100.00‡	68.00
Detroit (del.)	17.50	17.50	18.25	38.50	41.50
Baltimore	18.00	18.00	21.00	40.00	45.00
Atlanta	10.50	10.50	11.00	40.00	...
New Orleans	*17.50*	19.50	18.75	...	...
Birmingham	12.50	12.50	12.50@14	40.00	45.00
Philadelphia	19.00	19.00	22.00	38.00	46.00
Pittsburgh (del.)	16.00	16.00	16.00	...	...
Cleveland	*14.00*	14.00	16.00	...	...

*For paving blocks 3½x8½x3 and 3½x8½x4 respectively. †F.O.B. ‡Imported

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York: Dec. 6 on Trucks*	New York: One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy N. J., Factory*
4x12x12	$0.1162	$0.1179	...	$0.125	*$0.072*	$0.108	...
6x12x12	.1743	.1769	...	...	.097	.156	...
8x12x12	.2179	.2211	...	.215	*.132*	.244	...
10x12x12	...	...	...	...	*.165*	...	$0.2388
12x12x12	...	...	...	...	*.20*	...	.2956

*5 per cent off for cash.

	4x12x12	8x12x12	12x12x12
Boston	$0.125	*$0.225*	...
Minneapolis (f.o.b. cars)	.065	.11	$0.195
Minneapolis (delivered)	.07	.12	.21
Cincinnati	.07485	.13745	...
Kansas City	*.074*	*.138*	...
Denver	.085	.155	.188
Seattle (delivered)	.11	.20	.30
Los Angeles	.085	.172	...
New Orleans	.14	.24	...
Detroit (delivered)	*.0815*	*.1529*	...
Montreal	.12	.225	.30
Baltimore	.125	.27	...
Atlanta	.1004	.1674	...
Dallas	.0941	.1824	.265
Birmingham	.11	.175	...
Pittsburgh (delivered)	.068	.128	.179
Cleveland	*.064*	.149	...

San Francisco and New York quote on hollow partition tile.

STRUCTURAL MATERIAL—Following are base prices f.o.b. mill, Pittsburgh and Birmingham, together with quotations per 100 lb. from warehouses at place named:

	Pittsburgh Mill	Birmingham	Warehouse: New York	Warehouse: Dallas	Warehouse: St. Louis	Warehouse: Chicago	Warehouse: San Francisco
Beams, 3 to 15 in.	**$1.85@2.10**	$1.80@2.00	$3.34	$4.15	$3.25	$3.10	$3.00
Channels, 3 to 15 in.	**1.85@2.10**	1.80@2.00	3.34	4.15	3.25	3.10	3.00
Angles, 3 to 16 in., ¼ in. thick	**1.85@2.10**	1.80@2.00	3.34	4.15	3.25	3.10	3.00
Tees, 3 in. and larger	**1.85@2.10**	1.80@2.00	3.34	4.15	3.30	3.10	3.05
Plates, ¼ in. thick and heavier	**1.80@2.00**	1.60@1.90	3.34	4.15	3.25	3.10	3.00

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh Mill	Warehouse: New York, Dec. 4	Warehouse: New York, One Yr. Ago	Warehouse: Chicago	Warehouse: St. Louis	Warehouse: San Francisco	Warehouse: Dallas
½ in.	$2.60	$3.75	$4.40	$3.65	$3.65	$5.00	$4.75
CONE HEAD BOILER							
½ in.	*$2.75*	$3.85	$4.50	$3.75	$3.85	$5.20	$5.00
⅝ and ¾	*2.90*	4.01	4.66	3.85	4.10@4.35	5.35	5.15
⅞ and 1	*3.15*	4.25	4.90	4.10	4.50	5.60	5.50

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh Mill	Birmingham	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire	$2.75	*$2.90*	$3.25	$4.20	**$4.55**	*$3.14*	4.95
Cut	**$2.90@$3.00**	*3.10*	....	5.25	....	*3.39*	5.00

SHIP SPIKES—Current prices per 100 lb.:

In.	San Francisco: Galv.	San Francisco: Black	Seattle Black
¼	$8.00	$6.00	$7.75
⅜	7.30	5.30	5.40
½	7.15	5.15	5.50

Pittsburgh base in lots of 200 kegs or more, **$3.25**.

PREPARED ROOFINGS—Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $2.64 per roll to consumers in less than carload lots f.o.b. Philadelphia.

Single shingles, red and green slate finish, cost $6.95 per square (sufficient to cover 100 sq.ft.) in less than carload lots, f.o.b. Philadelphia. Strip shingles (4 in 1) f.o.b. Philadelphia, l.c.l., $6.05 per square.

ROOFING MATERIALS—Prices f.o.b. New York, to consumers in less than carload lots:

Tar felt (14 lb. per square of 100 sq.ft.) per ton	$85.73
Tar pitch (in 400-lb. bbl.), per 100 lb	2.13
Asphalt roofing (in barrels), per ton, f.o.b. plant*	40.50
Asphalt felt (light), per ton, f.o.b. plant*	87.75
Asphalt felt (heavy), per ton, f.o.b. plant*	87.75

* Delivered in Metropolitan Dist., $2.00 additional.

WINDOW GLASS—United inches, 25, bracket size 6x8 to 10x15, single thickness "AA," 82 per cent; "A," 86 per cent; "B," 88 per cent. Double thickness "AA," 82 per cent, "A," 85 per cent; "B," 88 per cent discount from jobbers list at New York warehouses.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10	$2.60@2.70	$3.90	$3.80	$3.95	$3.89
No. 12	2.70@2.80	3.95	4.05	4.00	3.94
No. 14	2.80@2.90	4.00	4.10	4.05	3.99
No. 16	3.00@3.10	4.10	4.20	4.15	4.09
Black					
*Nos. 18 and 20	3.25@**3.45**	4.45	4.55	4.80	4.40
*Nos. 22 and 24	3.30@**3.50**	4.50	4.55	4.85	4.45
*No. 26	3.35@**3.55**	4.55	4.60	4.90	4.50
*No. 28	3.40@**3.60**	4.65	4.50	5.00	4.60
Galvanized					
No. 10	3.50@**3.70**	4.65	4.60	4.90	4.60
No. 12	3.60@**3.80**	4.75	4.70	5.00	4.70
No. 14	3.60@**3.80**	4.75	4.70	5.00	4.70
Nos. 17 to 21	3.90@**4.10**	5.05	5.00	5.30	5.00
Nos. 22 and 24	4.05@**4.25**	5.20	5.15	5.45	5.15
*Nos. 25 and 26	4.20@**4.40**	5.55	5.30	5.60	5.30
*No. 28	4.50@**4.70**	5.65	5.50	5.90	6.60

* For painted corrugated sheets add 30c. per 1,000 lb. for 5 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

LINSEED OIL—These prices are per gallon:

	New York: Dec. 4	New York: One Year Ago	Chicago: Dec. 4	Chicago: One Year Ago
Raw in barrels (5 bbl. lots)	**$1.11**	$0.95	$1.05	$0.94

WHITE AND RED LEAD—In 100-lb. kegs, base price in cents per pound:

	Dry		In Oil	
	Dec. 4	1 Yr. Ago	Dec. 4	1 Yr. Ago
Red	$15.25	$14.00	$16.75	$15.50
White	15.25	14.00	15.25	14.00

LUMBER

Prices wholesale, per M. ft. b.m., to dealers in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in carload lots to dealers at yards. To contractors, $2 per M. ft. additional.

	6-8 and 12 Ft.	10-16-18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$28.00	$29.00	$30.00	$33.00
3x6 and 8	28.00	29.00	30.00	33.00
4x4-6 and 8	28.00	29.00	30.00	33.00
3x10 and 12	28.00	29.00	30.00	33.00
3x14	34.00	32.00	34.00	36.00
4x10 and 12	28.00	29.00	30.00	33.00
4x14	34.00	32.00	34.00	36.00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft.
6x10	$30.00	$32.00	$34.00
6x14	35.00	37.00	39.00
8x10	30.00	32.00	34.00
8x14	36.00	37.00	39.00

New York and Chicago—Wholesale prices to dealers of long leaf yellow pine.

	New York*		Chicago	
	20 Ft. and Under	22-24 Ft.	20 Ft. and Under	22-24 Ft.
3x4 to 8x8	*$38.00*	*$39.00*	.....	.....
3x10 to 10x10	*44.00*	*45.00*	.....	.....
3x12 to 12x12	50.00	51.00	.....	.....
3x14 to 14x14	57.00	58.00	.....	.....
3x16 to 16x16	**66.00**	**67.00**	.....	.....
3x18 to 18x18	.....	.....	.....	.....
4x20 to 20x20	.....	.....	.....	.....

* Wholesale price to dealers; to contractors, delivered from lighters or cars to job, $5 additional. Short leaf pine costs $3 per M. less.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12x12 and under, for sizes over 12x12 add $2, for merchantable add $2 to sizes 10x10 and under.

Other Cities

	8x8-In. x 20 Ft. and Under				12x12-In. 20 Ft. and Under	
	P.	Fir*	Hemlock	Spruce	P.	Fir*
Boston	$56.00	$54.00†	$50.00	$50.00	*$66.00*	$65.00†
Seattle	.....	29.50	.....	.....	.....	26.00
New Orleans	**30.50**	.....	.....	.....	**40.50**	.....
Baltimore	32.50	49.25	53.00	60.00	38.00	49.75
Cincinnati	40.00	74.00	74.00	88.00	44.00	78.00
Montreal	50.00	58.00	.....	.....	60.00	65.00
Los Angeles	.....	37.00	.....	.....	.....	38.00
Denver	.....	35.75	35.75	.....	.....	36.75
Minneapolis	**41.00**	**39.75**	39.00	.....	**44.10**	**39.75**
Atlanta	31.00	.....	.....	.....	34.00	.....
Dallas	52.25	.....	.....	.....	57.20	.....
Kansas City	39.50	.....	.....	.....	**48.50**	.....
Birmingham	32.00	.....	.....	.....	35.00	.....
Philadelphia	**60.00**	*33.00*	*40.00*	*40.00*	**68.00**	*33.00*
Detroit	46.25	49.75	.....	.....	56.75	58.75
St. Louis	*38.50*	.....	.....	.....	*50.00*	.....

	1-In. Rough, 10 In. x 16 Ft. and Under			2-In. T. and Gr. 10 In. x 16 Ft.	
	P.	Fir*	Hemlock	P.	Fir*
Boston	$46.00	$45.00†	$45.00	*$52.00*	*$51.00*†
Seattle	.....	25.00	.....	.....	29.00
New Orleans	**70.00**	.....	.....	**35.00**	.....
Baltimore	55.00	44.00	44.00	34.00	50.00
Cincinnati	75.00	80.00	75.00	38.00	88.00
Montreal	56.00	50.00	45.00	45.00	45.00
Los Angeles	.....	32.00	.....	.....	81.00
Denver	.....	**33.50**	**33.50**	.....	**31.50**
Minneapolis	43.00	**36.75**	35.50	37.00	**33.75**
Atlanta	19.00	.....	.....	29.00	.....
Dallas	52.25	.....	.....	55.75	.....
Kansas City	**72.25**	.....	.....	**72.75**	.....
Birmingham	63.00	.....	.....	67.00	.....
Philadelphia	**31.50**	*32.00*	*39.00*	**60.00**	*33.00*
Detroit	38.75	37.00	.....	42.50	38.50
St. Louis	43.00	.....	.....	*31.00*	.....

Birmingham—Quotes carload lots, f.o.b. sidings; $4.00 additional per M. ft. to contractors.
Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.
Denver—Quotes dealers price to contractors on large projects.
St. Louis—Wholesale price to contractors, f.o.b. cars, $2 per M.ft. additional.
Seattle—Price to contractors, delivered.
Dallas—Wholesale to contractors, $10 per M.ft. additional.
*Douglas fir. †Prime.

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York.

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.14½	$0.18½
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	.19	.23½
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	.21½	.25½
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	.25½	.34
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	.27½	.36½
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	.35	.41

MISCELLANEOUS

STEEL SHEETPILING—The following price is base per 100 lb. f.o.b. Pittsburgh, with a comparison of a month and a year ago:

Dec. 4	One Month Ago	One Year Ago
$1.95@2.05	$1.95@2.05	$2.65

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territory New York and East of Missouri River
Plow steel round strand rope	35%
Special steel round strand rope	30%
Cast steel round strand rope	20%
Round strand iron and iron tiller	5%
Galvanized steel rigging and guy rope	7½%
Galvanized iron rigging and guy rope	+12½%

California, Oregon, Nevada and Washington Discount: 5 points less than discount for Eastern territory.
Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.
Arizona: Discount 10 points less than discount for Eastern territory.
Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.
North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ¾-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ¼-in., 8 ft.; ⅜-in., 6; ½-in., 4½; ⅝-in., 3½; ¾-in., 2 ft. 10 in.; 1-in., 2 ft. 4 in. Following is price per pound for ¾-in. and larger, in 1200-ft. coils:

Boston	$0.17½@.22½	New Orleans	$0.21½
New York	.18½	Los Angeles	.19
Chicago	...	Seattle	.17
Minneapolis	.23½	St. Louis	.22½
San Francisco	.21	Montreal	.16
Atlanta	.19	Detroit	.19
Denver	.25	Baltimore	.18
Cincinnati	.21	Kansas City	.20½
Dallas	.21	Birmingham	.19@.22
Philadelphia	.18½		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0.27	$0.295
Boston	.23	.25
Kansas City	.2125	.2325
Seattle	.165	.19
Chicago	.....	.....
Minneapolis	.1917	.2123
St. Louis	.22	.245
Denver	.2025	.2275
Dallas	.225	.302
Los Angele	.1875	.2125
Atlanta	.23	.255
Baltimore	.22	.23
Cincinnati	.22	.245
Montreal	.195	.235
Birmingham	.23	.255
New Orleans	.235	.29
San Francisco	.1625	.1925
Philadelphia	.215	.24

CHEMICALS—Water and sewage treatment chemicals, spot shipments in carload lots, f.o.b. New York:

Sulphate of aluminum, in bags, per 100 lb	$1.35@1.40
Sulphate of copper, in bbl., per 100 lb	4.65@4.75
Soda ash, 58%, in bags, per 100 lb	1.25@1.45
Chlorine, liquid, cylinders, 100 lb., per lb. (f.o.b. works)	.05½@.07½
Hypochlorite of lime (bleaching powder) in drums, per 100 lb	*2.00@2.15*

FREIGHT RATES—On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Baltimore	$0.31	Detroit	$0.29
Birmingham	.58	Kansas City	.735
Boston	.365	New Orleans	.67
Buffalo	.265	New York	.34
Chicago	.34	Pacific Coast (all rail)	1.15*
Cincinnati	.29	Philadelphia	.32
Cleveland	.19	St. Louis	.43
Denver	1.15*	St. Paul	.60

* Minimum carload, 50,000 lb., structural steel only; 80,000 lb., for other iron or steel products.